A bibliographic database for the genus *Lathyrus*

compiled by

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The genus Lathyrus

In response to an ever increasing global demand for food and feed resources and the need to diversify modern cropping systems, the legume genus *Lathyrus* is receiving increased attention by agricultural scientists.
Kupicha (1976) lists 152 species in the genus (Table 2) which is distributed from the sub-arctic to the sub-tropics. It includes a range of grain, forage, pasture and ornamental crops (Table 1). The best known species include the ornamental sweet pea (*Lathyrus odoratus*) and the food legume grasspea (*Lathyrus sativus*).

Table 1 Cultivated *Lathyrus* species (adapted from Kearney & Smartt, 1995)

Species	Use
L. annuus	F, P
L. aphaca	F
L. blepharicarpus	P
L. cicera	F, P
L. clymenum	F, P
L. gorgoni	F
L. hirsutus	F
L. latifolius	O
L. ochrus	F, P
L. odoratus	O
L. pratensis	F
L. rotundifolius	O
L. sativus	F, P
L. sylvestris	F
L. tingitanus	F
L. tuberosus	T

P: Pulse; F: Fodder, forage; O: Ornamental; T: Tubers

Genetic resources

The currently *ex-situ* conserved genetic resources of the genus are mainly restricted to 86 species (FAO, 1993 data). A thorough assessment of the conservation status (*ex-situ*, *in-situ*) for the genus and the range of diveristy conserved for individual species is currently being undertaken by IPGRI. In this bibliography particular attention has been given to the inclusion of information about the floras of regions where *Lathyrus spp*. occur, since floras can contain information about collection sites, habitat, economic botany and the older literature. Although the major utilitarian focus is on Mediterranean *Lathyrus* species, the genus is no means restricted to this region and others like North-, South-America and Central Asia also offer considerable biodiversity.

Toxicity

The presence of toxic non protein amino acids (NPAAs) in the seeds of *Lathyrus* species have restricted their agricultural development in several countries

Chemotaxonomic studies in the early 1960s established the presence of several toxic amino acids in the seeds of different taxonomic groups. This work provided a useful frame of reference to delineate groups of species with different seed toxins.

Three NPAAs of concern are the neurotoxins Beta-oxalyl-diamino-propionic acid (Beta-ODAP) (*L. sativus*), Diamino-butyric acid (DABA) (*L. sylvestris*) and the nitrile containing beta-amino-propionitrile (BAPN) (*L. odoratus*).

The bone deforming (osteolathyrogenic) properties of *Lathyrus odoratus* are due to the presence of BAPN. This compound affects the cross-linking of collagen during bone and connective tissue formation. The resultant disease is known as osteolathyrism. Recent studies in Bangladesh suggest that a metabolic precursor for this compound, 2-cyanoethyl-isoxazolin-5-one is present in the vegetative parts and immature seeds of *L. sativus*. It appears responsible for the osteolathyrogenic symptoms observed in some neurolathyrism patients who had consumed vegetative parts of *L. sativus*.

The neurotoxicity of *Lathyrus sylvestris* and related species is caused by the toxic NPAA DABA.

With the identification of the amino acid beta-ODAP as a toxin, it has become possible to select low ODAP genotypes of *L. sativus*. Such cultivars are now available from Canadian and, to a limited extent, from Indian research programs. Their existence has renewed interest in the further development of this species as a pulse crop.

Lathyrism

There are two different types of lathyrism, neurolathyrism and osteolathyrism, affecting the nervous system and bone formation respectively. The term "Human Lathryism syndrome" (HLS or HULAS) was coined to describe the rather diverse clinical and biochemical symptoms (incl. osteolathyrism) caused by *L. sativus* (Cohn, 1995).

Cohn and Streifler (1981, 1983) have described, in addition to neurological damage, osteolathyrogenic symptoms in lathyrism patients who had 35 years earlier consumed food prepared from *L. sativus* seed in a German forced labour camp. This finding suggest that extreme care is needed with the toxicity assessment of low-ODAP strains of *L. sativus* because other toxins may be present in the seeds under certain conditions e.g. seed immaturity.

Medical scientists are interested in the causes of neurolathyrism as a model for neurodegenerative diseases striking the more affluent sections of the human population. The scourge of neurolathyrism, known since ancient times, today affects mainly the poorer rural classes especially in India, Bangladesh, Ethiopia, Nepal and Pakistan during drought caused famines. Historic outbreaks of this neurological crippling disease have also been documented for Spain, Algeria, Ukraine, Russia, Germany, Italy, France, Syria and most recently from 1972-74 in China. The cause of neurolathyrism is the continued consumption of *L. sativus* seed as a staple food. Other *Lathyrus* species have also occasionally been linked with neurolathyrism e.g. *L. cicera*, *L. ochrus* and *L. clymenum*. These species all contain beta-ODAP in their seeds.

Lathyrism and Poverty

The occurrence of neurolathyrism is intricately linked to drought caused famine, poverty and malnutrition. The hardy *L. sativus* may provide most of the food for survival during drought in areas where neurolathyrism is prevalent.

Whether the new low toxin strains will survive under adverse conditons remains to be seen. Detoxification techniques for strains with high beta-ODAP provide some measure to reduce the impact of neurolathyrism, however, as was pointed out by Kearnick and Smartt (1995), the costs in fuel and water may prevent such practise where it is most needed. Recent advances in solar cooking technology through the provision of cheap, easily built solar ovens may reduce the future need for solid and fossil fuels in some regions. Governments need to pay attention to the potential threat of neurolathyrism and provide contingency plans to deal with high risk areas during times of famine. Reduction of poverty and malnutrition in lathyrism prone areas are likely to provide the best solution to this problem.

The development of *L. sativus* as a safe food crop, not only for Bangladesh, India, Nepal and Ethiopia but also for the peoples of countries with suitable climates to grow this crop (Canada, Chile, Spain, North Africa, Middle East, Afghanistan, Australia etc.) necessitates a good understanding of the conditions and predisposing factors which lead to the onset of neurolathyrism.

Models for neurolathyrism and human safety

Experimental monogastric animal models for ODAP toxicity are needed. In the absence of suitable protocols to provoke neurolathyrism through oral administration of toxic diets in experimental animals, no safety margin for below-threshold ODAP toxicity can be set. Existing toxicological protocol does not provide for the determination of safe *L. sativus* consumption levels.

Consumption of *L. sativus* by humans appears to be much safer than previously thought. Large populations in India, Bangladesh and Ethiopia are consume this crop on a regular basis. Dr. Kothari in India argues that *L. sativus* is a safe food and has sparked considerable controversy. Others consider such publicity irresponsible and would rather like to see efforts directed towards better understanding the causes of neurolathyrism. It should not be ignored that malnutrition is an important and constant factor of neurolathyrism epidemiology.

A monogastric malnutrition model for neurolathyrism, coupled with detailed research into variation in human ODAP metabolism is likely to provide the best approach to define toxicity levels of this glutamate analogue. In addition, the possibility of other toxins and predisposing factors leading to HLS need to be understood. Without a thorough understanding of the real cause(s) of neurolathyrism and the variability in susceptibility of individuals to it, the bright future of grain crops like *L. sativus* is handicapped by the stigma of their toxicity. With a thorough knowledge of *Lathyrus* toxicity and sufficient genetic resources several other species of this diverse genus may well be developed as food crops.

Animal fodder

Lathyrus fodder crops have been utilised for millennia. It appears that high intake of *Lathyrus* fodder from BAPN and DABA biosynthesizing species has frequently led to ruminant intoxications. Adaptation by ruminants to such forages has also been reported, whereas horses and pigs can be poisoned by any *Lathyrus* forage. Lathyrism in horses has been an important military problem in the past.

Biomass production by native and introduced legumes has been an incentive for cultivation since the inception of agriculture. Familiarity with naturalised crops and their toxicity has generally resulted in the avoidance of toxic plants and selection of palatable plants for food and feed. Selection amongst existing landraces for adaptation to specific environments and transfer of traditional knowledge about their utilisation provides the basis of new crop options for global agriculture.

Technical matters

Following the work of Davies *et al*. (1993a) this bibliography was compiled as a database using Procite® and Biblio-Link® bibliographic software. The aim was to demonstrate the utility of personal bibliographic software (PBS) for the management of subject specific information. This collection provides access to the older literature which cannot be retrieved from current databases. The software facilitates rapid retrieval of information through searches of the database or its indexes. It also allows a range of citation formats to suit even the most discerning editor.

Abstracts and references were initially compiled from a wide search for *Lathyrus* related subject matter using Agricola (1970-1984), CAB (1984- June1994), BIOSIS (1991- June 1993) and Medline (1966-1993) CD-ROM data spanning the period 1970-1993. Search strategy: *Lathyrus* or grasspea or (grass and pea) or chickling or lathyrism. These records were imported into Procite 2.02 with the help of the bibliolink 1.1 software for silverplatter. Extensive editing was required to achieve a homogeneous format. This computerised search was complemented by a thorough check of Herbage Abstracts (HA) for *Lathyrus* back to the year 1931. Additional citations were obtained from the *Lathyrus* literature and for taxonomic references from the USDA pcGRIN database for *Lathyrus* [*Lathyrus*.exe]. ICARDA kindly provided additional entries from CODIS (1975-1995). Some references were obtained from Dissertation abstracts and the most recent citations originate from Current contents. The more recent version of Biblio-Link® II was used to import these records with ease and flexibility thus necessitating only minor editing. Spell checking of the database was achieved by exporting the records to a text file and then importing this file in MS-Word 6.0.

This bibliography provides a thorough coverage of the agricultural, botanical, chemical, biochemical and medicinal literature related to the genus *Lathyrus* and neurolathyrism.

Every attempt has been made to make this collection as complete as possible. It is, however, just the start for future additions. It is hoped that others will join in the effort to make future editions more comprehensive.

In order to assist researchers and other interested individuals to utilise the collected information, CLIMA and ICARDA have agreed to publish this bibliography in both electronic format (CD-ROM) and as a hard copy. With such a comprehensive bibliography the foundations are laid for a truly encyclopedic database for the genus *Lathyrus*.

Bibliographic databases as the nucleus for assembling the body of knowledge on a given topic

A PC database format facilitates a mini expert system. Such a system is only as good as its programmer, so improvements can clearly be made in collaboration with others. Collectively, the expertise and knowledge related to the genus *Lathyrus* could be gathered into a living monograph through a continual reviewing, editing and addition process. Free access to this knowledge depends on whoever controls the copyright.

It is perceivable that in the near future, books are to be published primarily in electronic format. Monographs may take on the shape and form of encyclopedic multimedia databases, encompassing all available knowledge on a given topic. Revisions, discussions and updates of particular areas can be part of an ongoing process.

A book needs to be reprinted for every update but a database monograph can be continually updated thus providing a comprehensive, up-to-date and unified body of knowledge on the subject. Provision of collection points for individual contributions in the form of bibliographies such as this one, for information which currently is not freely accessible by computer, facilitates the creation of ever more complete knowledge databases.

It is hoped that the present work provides a stimulus for similar activity with other crops and research interests. A bibliographic database like the present one on the topic *Lathyrus* can be crosslinked to data and full text publications, archives, genetic resource inventories, evaluation data, maps and models, spatially referenced data etc. With publications in CD-ROM format and the vast possibilities of the internet, a great deal of storage space is available for other information to be added in future editions.

Subject indexes

An attempt has been made to index each record with a minimum of 3 key words to provide several independent access routes to it. In many records the format “species”, “species topic” and “topic species” has been used to provide three separate index entries, so that records do not get lost in the database. Species occurrence is noted, especially for floras, and sometimes includes synonyms. All *Lathyrus* species in the index were searched for individually in the database. Taxonomic indexing is useful for the retrieval of information on the rarer species, it also provides an index of the lack of knowledge about these lesser known species of the genus.

Some references (mainly those extracted from pcGRIN) appear in abbreviated notation which should be familiar to taxonomic botanist. Species names indexed with their authority name refer to publications where they were authoritatively described. Further details about the taxonomic literature of the genus *Lathyrus* can be obtained from ILDIS.

Publication of a printout from the database necessitated the creation of a subject index in order to facilitate manual location of appropriate records. For the subject

index, full text searches of the bibliographic database using major topics and each legume or crop species were carried out to facilitate manual retrieval of records from the hard copy. The index terms are of heterogeneous origin, since a fair portion of the records in this database originated from other databases e.g Agricola, CAB, BIOSIS., AGRIS and Medline. Additional index terms were created during the manual addition of records from Herbage Abstracts and literature citations. Some overlap occurred as a consequence. Plant species are indexed by their latin binomials. Legume species were included in the index when mentioned in the abstract, in order to provide linking terms with any future bibliographies.

It is possible that some records may have been indexed erroneously. Several topics have been indexed using a combination of index terms thus increasing the possibility of mistakes. Seemingly unrelated subject links were included where it felt appropriate to draw interested readers to a particular subject e.g. poverty, socioeconomics and malnutrition.

Reprint collections

Records for which reprints have been obtained are labelled as such (Reprint= CLIMA collection, reprintDE= Dirk Enneking collection). The location and assembly of a reprint collection for the remainder of the literature is a formidable task and may take decades to accomplish. A safe depository or archive for this collection also needs to be found to guarantee access for future generations. Receival of reprints and photocopies, especially copies of articles from the older literature and the rarer journals would be very welcome. Other reprint collections should be documented and noted in updates of the database to facilitate access to literature.

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Libraries

The following libraries with extensive collections were visited or consulted for this bibliography:

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Barr Smith Library, University of Adelaide
Bibliothek der Tierärztlichen Hochschule, Hannover, Germany
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Harold Woolhouse library, Waite Agricultural Research Institute, University of Adelaide, South Australia;
ICARDA, Aleppo, Syria
Instituto Nacional de Investigaciones Agrarias, Ctra. De la Coruna, 7, Madrid, Spain
ISIS http://www.nalusda.gov/isis/
Library of the Adelaide Botanical Gardens (Herbals, Floras)
Library of the Ibero-American Institute, Potsdamer Platz, Berlin, Germany (Spanish literature)
Library of the IPK, Gatersleben
Library of the Royal Botanic gardens, Kew, Great Britain
Rothamstedt library, Harpenden, Great Britain
Staatsbibliothek Zu Berlin -Preussischer Kulturbesitz, Potsdamer Platz, Berlin, Germany
USDA National Agricultural library (NAL)
Zentralbibliothek der Landbauwissenschaft und Abteilungsbibliothek für Naturwissenschaft und vorklinische Medizin, Bonn, Germany
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Dr. W. Junk Publishers, Netherlands: Genetica, Qualitas Plantarum/Plant Foods for Human Nutrition
Elsevier Science B.V., Amsterdam, Netherlands: Biochimica et Biophysica Acta, Brain Research, FEBS Letters, Immunology Letters
Elsevier Science Ireland Ltd.: Neuroscience Letters, Toxicology Letters (Amsterdam)
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Ethiopian Medical Journal: Ethiopian Medical Journal
Folia Histochem Cytochem Krakow: Folia Histochemica et Cytobiologica
Gustav Fischer Verlag, Stuttgart: Zentralbl Bakteriol Naturwiss
International Society for Horticultural Science: Acta Horticulturae
Kluwer Academic Publishers, Netherlands: Euphytica
Macmillian Journals Ltd, UK: Brain
Marcel Dekker Inc.: Communications in Soil Science and Plant Analysis, Preparative Biochemistry
Masson S.A. Paris, France: Bull. Soc Pathol Exot Filiales
Raven Press: Journal of Neurochemistry
S Karger AG, Basel, Switzerland: European Neurology
Springer Verlag: Acta Neuropathol Berl, Arch Toxicol Supplement, European Journal of Biochemistry, Experimental Brain Research, Theoretical and Applied Genetics
Stockton Press: Paraplegia
The Biochemical Society: Biochemical Journal
Walter de Gruyter & Co., Berlin: Biol Chem Hoppe Seyler

Journals

Journal	Publisher
Acta Horticulturae	International Society for Horticultural Science
Acta Neurologica Scandinavica	Munksgaard Publishers
Acta Neuropathol Berl	Springer Verlag
American Journal of Tropical Medicine and Hygiene	American Journal of Tropical Medicine and Hygiene
Analytical Biochemistry	Academic Press
Arch Toxicol Supplement	Springer Verlag
Arch. Biochem. Biophys,	Academic Press
Biochemical Journal	The Biochemical Society
Biochemistry	American Chemical Society
Biochimica et Biophysica Acta	Elsevier Science B.V., Amsterdam, Netherlands
Biol Chem Hoppe Seyler	Walter de Gruyter & Co., Berlin
Brain	Macmillian Journals Ltd, UK
Brain Research	Elsevier Science B.V., Amsterdam, Netherlands
British Poultry Science	Carfax Publishing Company, UK
Bull. Soc Pathol Exot Filiales	Masson S.A. Paris, France
Communications in Soil Science and Plant Analysis	Marcel Dekker Inc
Cytologia, Tokyo	Cytologia, Tokyo
Environmental Research	Academic Press
Ethiopian Medical Journal	Ethiopian Medical Journal
Euphytica	Kluwer Academic Publishers, Netherlands
European Journal of Biochemistry	Springer Verlag
European Neurology	S Karger AG, Basel, Switzerland
Experimental Brain Research	Springer Verlag
FEBS Letters	Elsevier Science B.V., Amsterdam, Netherlands
Folia Histochemica et Cytobiologica	Folia Histochem Cytochem Krakow
Fundamental and Applied Toxicology	Academic Press
Genetica	Dr. W. Junk Publishers, Netherlands
Heredity	Blackwell Science Ltd.
Immunology Letters	Elsevier Science B.V., Amsterdam, Netherlands
Journal of Biological Chemistry	American Society of Biological Chemists Inc., USA
Journal of Ecology	Blackwell Science Ltd.
Journal of Neurochemistry	Raven Press
Neuroscience Letters	Elsevier Science Ireland Ltd.
Paraplegia	Stockton Press
Phytochemistry	Elsevier Science Ltd., The Boulevard, Langford Lane
Preparative Biochemistry	Marcel Dekker Inc
Qualitas Plantarum/Plant Foods for Human Nutrition	Dr. W. Junk Publishers, Netherlands
Soil Biology and Biochemistry	Elsevier Science Ltd., The Boulevard, Langford Lane
Theoretical and Applied Genetics	Springer Verlag
Toxicology and Applied Pharmacology	Academic Press
Toxicology Letters (Amsterdam)	Elsevier Science Ireland Ltd.
Veterinary and Human Toxicology	American College of Veterinary Toxicologists
Zentralbl Bakteriol Naturwiss	Gustav Fischer Verlag, Stuttgart

Abbreviations

Annotations are initialled by author.

Agricola	USDA agricultural literature database
AGRIS	FAO agricultural literature database
BB	BeanBag
BIOSIS	BiosSiences Information Services (Biological abstracts)
BOAA	beta-oxalyl-amino-alanine (=ODAP)
CA	Chemical Abstracts
CAB	Commonwealth Agricultural Bureau
CD-ROM	Computer Disc-Read Only Memory
CGC_95_2	references added by Clayton G. Campbell February 1995
CLIMA	Centre for Legumes in Mediterranean Agriculture
CP	Crude protein
Cv	Cultivar
D.E.	Dirk Enneking comments
DABA	Diamino butyric acid
DM	Dry matter
ENSA	Ecole Nationale Superieur d'Agricole
FAO	Food and Agriculture Organization of the United Nations
FL	Fernleihe=Interlibrary loan
HA	Herbage Abstracts
i.v.	intravenous injection
ICARDA	International Centre for Agricultural Research in Dry Areas
IPGRI	International Plant Genetic Resources Institute
ISIS	Integrated system for information services
LWB	Landwirtschaftliche Bibliothek, Bonn
M.E.T.	Max E. Tate comments
Medline	Medical abstract information service
NAL	National Agricultural library, USDA
NPAA	Non protein amino acid
UWA	University of Western Australia
ODAP	Oxalyl-diamino-propionic acid
PBS	Personal bibliographic software
PC	Personal computer
pcGRIN	Personal Computer Genetic Resource Information System
TRANSL	Translation
UB	Unibibliothek-Adenauer Allee, Bonn
USDA	United States Department of Agriculture

Table 2. The genus *Lathyrus* (Kupicha, 1976)

Gen	Species	Author	*Section*
L	*alpestris*	(Waldst. & Kit.) Kit.	*Orobus*
L	*amphicarpos*	L.	*Lathyrus*
L	*angulatus*	L.	*Linearicarpus*
L	*annuus*	L.	*Lathyrus*
L	*aphaca*	L.	*Aphaca*
L	*arizonicus*	Britton	*Orobus*
L	*armenus*	(Boiss. & Huet) Celak	*Lathyrostylis*
L	*atropatanus*	(Grossh.) Sirj.	*Lathyrostylis*
L	*aureus*	(Steven) Brandza	*Orobus*
L	*basalticus*	Rech. F.	*Lathyrus*
L	*bauhinii*	Genty	*Lathyrostylis*
L	*bertianus*	Colla	*NotoLathyrus*
L	*bijugatus*	T. White	*Orobus*
L	*binatus*	Pancic	*Pratensis*
L	*blepharicarpus*	Boiss.	*Lathyrus*
L	*boissieri*	Sirj.	*Lathyrostylis*
L	*brachycalyx*	Rydb.	*Orobus*
L	*brachypterus*	Celak.	*Lathyrostylis*
L	*cabrerianus*	Burkart	*NotoLathyrus*
L	*campestris*	Philippi	*NotoLathyrus*
L	*cassius*	Boiss.	*Lathyrus*
L	*chloranthus*	Boiss.	*Lathyrus*
L	*chrysanthus*	Boiss.	*Lathyrus*
L	*cicera*	L.	*Lathyrus*
L	*cilicicus*	Hayek & Siehe	*Lathyrostylis*
L	*ciliolatus*	Rech. F.	*Lathyrus*
L	*cirrhosus*	Ser.	*Lathyrus*
L	*clymenum*	L.	*Clymenum*
L	*cyaneus*	(Steven) K. Koch	*Lathyrostylis*
L	*czeczottianus*	Baessler	*Pratensis*
L	*davidii*	Hance	*Orobus*
L	*delnorticus*	C. Hitchc.	*Orobus*
L	*dielstanus*	Harms	*Orobus*
L	*digitatus*	(M. Bieb.) Fiori	*Lathyrostylis*
L	*dominianus*	Litv.	*Orobus*
L	*elongatus*	(Bornm.) Sirj.	*Lathyrostylis*
L	*emodi*	Fritsch	*Orobus*
L	*eucosmus*	Butters & St. John	*Orobus*
L	*filiformis*	(Lam.) Gay	*Lathyrostylis*
L	*frolovii*	Rupr.	*Orobus*
L	*gloeospermus*	Warb. & Eig.	*Clymenum*
L	*gmelinii*	Fritsch	*Orobus*
L	*gorgoni*	Parl.	*Lathyrus*
L	*graminifolius*	(S. Watson) T. White	*Orobus*
L	*grandiflorus*	Sibth. & Smith	*Lathyrus*
L	*hallersteinii*	Baumg.	*Pratensis*
L	*hasslerianus*	Burkart	*NotoLathyrus*
L	*heterophyllus*	L.	*Lathyrus*
L	*hierosolymitanus*	Boiss.	*Lathyrus*
L	*hirsutus*	L.	*Lathyrus*
L	*hirticarpus*	Mattatia & Heyn	*Lathyrus*
L	*hitchcockianus*	Barneby & Reveal	*Orobus*
L	*holochlorus*	(Piper) C. Hitchc.	*Orobus*
L	*hookeri*	G. Don	*NotoLathyrus*
L	*humilis*	(Ser.) Sprengel	*Orobus*
L	*hygrophilus*	Taubert	*Linearicarpus*
L	*inconspicuus*	L.	*Linearicarpus*
L	*incurvus*	(Roth) Willd.	*Orobus*
L	*japonicus*	Willd.	*Orobus*
L	*jepsonii*	E. Greene	*Orobus*
L	*karsianus*	P. H. Davis	*Lathyrostylis*
L	*komarovii*	Ohwi	*Orobus*
L	*krylovii*	C. Serg.	*Orobus*
L	*laetiflorus*	E. Greene	*Orobus*
L	*laevigatus*	(Waldst. & Kit.) Gren.	*Orobus*
L	*lanszwertii*	Kellogg	*Orobus*
L	*latifolius*	L.	*Lathyrus*
L	*laxiflorus*	(Desf.) Kuntze	*Pratensis*
L	*layardii*	Ball ex Boiss.	*Pratensis*
L	*ledebouri*	Trautv.	*Lathyrostylis*
L	*lentiformis*	Plitm.	*Lathyrus*
L	*leucanthus*	Rydb.	*Orobus*
L	*libani*	Fritsch	*Orobus*
L	*linearifolius*	Vogel	*NotoLathyrus*
L	*linifolius*	(Reichard) Baessler	*Orobus*
L	*littoralis*	(Nutt.) Endl.	*Orobus*
L	*lomanus*	I. M. Johnston	*NotoLathyrus*
L	*longipes*	Philippi	*NotoLathyrus*
L	*lycicus*	Boiss.	*Lathyrus*
L	*macropus*	Gillies	*NotoLathyrus*
L	*macrostachys*	Vogel	*NotoLathyrus*
L	*marmoratus*	Boiss. & Blanche	*Lathyrus*
L	*mulkak*	Lipsky	*Lathyrus*
L	*multiceps*	D. Clos	*NotoLathyrus*
L	*nervosus*	Lam.	*NotoLathyrus*
L	*neurolobus*	Boiss. & Heldr.	*Neurolobus*
L	*nevadensis*	S. Watson	*Orobus*
L	*niger*	(L.) Bernh.	*Orobus*
L	*nigrivalvis*	Burkart	*NotoLathyrus*
L	*nissolia*	L.	*Nissolia*
L	*nivalis*	Hand.-Mazz.	*Lathyrostylis*
L	*occidentalis*	(Fischer & Meyer) Fritsch	*Orobus*
L	*ochroleucus*	Hook. f.	*Orobus*
L	*ochrus*	(L.) DC	*Clymenum*
L	*odoratus*	L.	*Lathyrus*
L	*pallescens*	(M. Bieb.) K. Koch	*Lathyrostylis*
L	*palustris*	L.	*Orobus*
L	*pancicii*	(Jurisic) Adamovic	*Lathyrostylis*
L	*pannonicus*	(Jacq.) Garcke	*Lathyrostylis*
L	*paraguayensis*	Hassler	*NotoLathyrus*
L	*paranensis*	Burkart	*NotoLathyrus*
L	*parodii*	Burkart	*NotoLathyrus*
L	*parvifolius*	S. Watson	*Orobus*
L	*pauciflorus*	Fern.	*Orobus*
L	*phaselitanus*	Huber-Mor. & P. H. Davis	*Lathyrus*
L	*pisiformis*	L.	*Orobus*
L	*polymorphus*	Nutt.	*Orobus*
L	*polyphyllus*	Nutt.	*Orobus*
L	*pratensis*	L.	*Pratensis*
L	*pseudo-cicera*	Pampan.	*Lathyrus*
L	*pubescens*	Hook. & Arn.	*NotoLathyrus*
L	*pusillus*	Elliott	*NotoLathyrus*
L	*quinquenervus*	(Miq.) Litv.	*Orobus*
L	*rigidus*	T. White	*Orobus*
L	*roseus*	Steven	*Orobon*
L	*rotundifolius*	Willd.	*Lathyrus*
L	*satdaghensis*	P. H. Davis	*Lathyrostylis*
L	*sativus*	L.	*Lathyrus*
L	*saxatilis*	(Vent.) Vis.	*Viciopsis*
L	*setifolius*	L.	*Orobastrum*
L	*spathulatus*	Celak.	*Lathyrostylis*
L	*sphaericus*	Retz.	*Linearicarpus*
L	*splendens*	Kellogg	*Orobus*
L	*stenolobus*	Boiss.	*Aphaca*
L	*stenophyllus*	Boiss. & Heldr.	*Lathyrus*
L	*subandinus*	Philippi	*NotoLathyrus*
L	*subulatus*	Lam.	*NotoLathyrus*
L	*sulphureus*	Brewer	*Orobus*
L	*sylvestris*	L.	*Lathyrus*
L	*tauricola*	P. H. Davis	*Linearicarpus*
L	*tingitanus*	L.	*Lathyrus*
L	*tomentosus*	Lam.	*NotoLathyrus*
L	*torreyi*	A. Gray	*Orobus*
L	*trachycarpus*	(Boiss.) Boiss.	*Lathyrus*
L	*tracyi*	Bradshaw	*Orobus*
L	*transsilvanicus*	(Sprengel) Reichb. f.	*Orobus*
L	*tremolsianus*	Pau	*Lathyrus*
L	*tropicalandinus*	Burkart	*NotoLathyrus*
L	*tuberosus*	L.	*Lathyrus*
L	*tukhtensis*	Czeczott	*Lathyrostylis*
L	*undulatus*	Boiss.	*Lathyrus*
L	*vaniottii*	Leveille	*Orobus*
L	*variabilis*	(Boiss. & Kotschy) Celak.	*Lathyrostylis*
L	*venetus*	(Miller) Wohlf.	*Orobus*
L	*venosus*	Muehlenb.	*Orobus*
L	*vernus*	(L.) Bernh.	*Orobus*
L	*vestitus*	Nutt.	*Orobus*
L	*vinealis*	Boiss. & Noe	*Linearicarpus*
L	*whitei*	Kupicha	*Orobus*
L	*wilsonii*	Craib	*Orobus*
L	*woronowii*	Bornm.	*Linearicarpus*
L	*zionis*	C. Hitchc.	*Orobus*

Lathyrus database: Lathyrism <1970 Bibliography

leg. D. Enneking May 2003

Ramazzani, B. (1691). **Constitutio epidemica anni 1691 ad Leibnitzium**. Mutin:quarto.
Observed patients in the dukedom of Modena who suffered from a weakness of the lower extremities as consequence of eating 'legumi', especially 'ervo' . [D.E.: Is 'ervo' L. cicera or V. ervilia?].
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy/ Italy lathyrism/ Lathyrus/ Vicia ervilia toxicity/ History lathyrism/ Lathyrism history/ Lathyrus cicera toxicity/ Lathyrus cicera History/ Italy/ Lathyrism/ Lathyrism L. cicera/ Lathyrus toxicity/ Toxicity L. cicera/ Toxicity/ Vicia/ Vicia ervilia.

Ramazzini, B. (1739). **Constitutio epidemica urbana omni, 1691, Art. 32**. **Opera Omnia**, Londini: Vol. 1, p. 145.
Source: ref ex Selye (1957); Jiménez Díaz (1941)
Lathyrism Italy/ Italy lathyrism/ Lathyrism history/ History/ Italy/ Lathyrism.

Duvernoy, G. D. (1770). **Dissertazione de Lathyri quadam Venenata Specia in Comitato Montbelgardensi cultur**. Basiliae.
Consumption of L. cicera seeds caused stiffness of feet (joints) in men.
Source: ref ex Schuchardt (1885-87); Moya et al 1967
Lathyrism history Germany/ Lathyrus/ Lathyrus cicera toxicity/ Toxicity L. cicera/ Lathyrism Germany/ Germany lathyrism/ Lathyrus cicera/ Germany/ History/ Lathyrism/ Lathyrism history/ Lathyrism L. cicera/ Lathyrus toxicity/ Humans/ Seed/ Toxicity.

Linguet and Tissot (1780). **Ueber das Getreide und Brod, nebst Geschichte einer giftigen Art Erbsen**. Zuerich, octavo.
L. cicera or L. sativus consumption led to leg paralysis; (translated from French into German by Hirzel, 1780).
Source: ref ex Schuchardt (1885-87)
Lathyrus toxicity/ Lathyrism history/ Lathyrus sativus/ Lathyrus cicera/ Germany/ History/ Human consumption/ Lathyrism/ Lathyrism Germany/ Lathyrism L. cicera/ Humans/ Paralysis/ Toxicity L. cicera/ Toxicity L. sativus/ Toxicity/ Translation.

Von Hirzel, F. (1780). **Ueber das Getreide und Brod (About, over grain and bread). Vol. 8**. Zuerich: Linguet and Tissot.
Source: ref ex Selye (1957)
Lathyrus bread grain/ Bread/ Lathyrism Germany.

Tozzetti, O. T. (1785 (circa)). **Sulla Lathyrus cicera**. Atti Della Soc. Econom. Di Firenze **2**:96
Source: ref ex Schuchardt (1885-87)
Lathyrus cicera toxicity/ Lathyrism L. cicera/ Lathyrism history/ Lathyrus cicera/ History/ Lathyrism/ Lathyrus toxicity/ Toxicity L. cicera Toxicity.

Tozzetti, O. T. (1793). **Memoria letta nell'adunanza della R. Accademia dei Georgofili di Firenze 1 di 3. Agosto dal Dott. Ott. T. Tozzetti, Socio di detta Academia, P. prof. di Botanica etc. Accresciuta adesso di note, e di copiose aggiunte del medesimo (72 pp.)**. Firenze.
Lathyrism in Toskana in 1784. Bread 1 part cereal 2 parts Lathyrus sativus imported from Tunisia caused paralysis after three months consumption. Plants were identified after growing them out in the botanical garden.
Source: ref ex Schuchardt (1885-87)
Lathyrus sativus toxicity/ Lathyrism history/ Italy Toscana lathyrism/ Lathyrism Italy Toscana/ Lathyrus sativus/ Bread/ Dhal/ History/ Italy Italy L. sativus/ Italy lathyrism/ Lathyrism/ Lathyrism Italy/ Lathyrus toxicity/ North Africa/ Africa North/ Paralysis/ Toxicity L. sativus Toxicity/ Tunisia.

Deslandes (1820 (circa)). **Nachteilige Wirkung des Genusses der Vicia monanthes**. Biblioth. Physico-Economique **3**:330.
Deslandes (Thiebaud de Bernard). Reported similar cases as Vilmorin (1847) from the Department de la Sarthe, France in the Journal des Maires [DE??]. Also see Heusinger (1821).
Source: ref ex Schuchardt (1885-87) 1885-87
Vicia monantha toxicity/ Vicia toxicity/ Lathyrus toxicity/ Lathyrism/ France/ Vicia/ Canavanine/ Lathyrism France/ Toxicity/ Vicia monantha Vilmorin.

Heusinger, C. F. (1821). **Deslandes zu Bazouges bei La Fleche, Nachtheilige Wirkung von Vicia monanthes (Thiebaud de Bernard, biblioth. physico-economique. Tome 3, p. 330), mitgetheilt und mit einer Nachschrift versehen**. Rust's Magazin Fuer Heilkunde **9**:357-361
Source: ref ex Schuchardt (1885-87)

Lathyrus/ Lathyrism/ Vicia monantha toxicity/ France/ Vicia/ Canavanine/ Vicia monantha/ Toxicity V. monantha/ Fungi/ Mycology Lathyrism France/ Lathyrus toxicity/ Microbiology/ Rust/ Toxicity.

Desparanches, F. (1829). **Le lathyrisme**. Bull. Scient. Méd **18**:433
Source: ref ex Selye (1957), read abs only
Lathyrism.

Marshall, H. (1833-1835). **Notes on the medical topography of Ceylon**. Art. 'Barbier' in Cycl. Pract. Med
Source: ref ex Selye (1957)
Lathyrism Ceylon/ Ceylon lathyrism/ Ceylon/ Lathyrism.

Sleeman, W. H. (1836-1844). **Rambles and recollections of an Indian official, octavo, 2 vols**. London. vol. 1 Sangor, India, 1833, several lathyrism cases following 3 years of poor cereal harvests, famine and L. sativus being major part of the diet as a consequence.
Source: ref ex Schuchardt (1885-87)/Selye (1957)
Famine India/ Lathyrism India/ History lathyrism/ Lathyrism history/ India lathyrism/ Famine/ Malnutrition/ Lathyrus sativus/ Diet/ History India/ India Dietary/ Dietary/ India L. sativus/ India malnutrition/ Lathyrism.

Desbauts (1840). Bulletin De Chirurgie **19**.
Refers to animal feeding experiments with Lathyrus seeds carried out by Cottereau and Caignon. These were unable to produce lathyrism symptoms in dogs, rabbits and hens.
Source: ref ex Schuchardt (1885-87)
Rodents/ Canine bioassay/ Poultry bioassay/ Bioassay poultry/ Bioassay rodents/ Bioassay canine/ Lathyrus sp. toxicity/ Lathyrism/ Bioassay Agriculture/ Lathyrism symptoms/ Animal feeding/ Dogs/ Feeding/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrus sp./ Lathyrus toxicity Poultry/ Rabbits/ Seed/ Symptoms lathyrism/ Toxicity rodents bioassay/ Toxicity.

Tribunal de Niort (1840). Journal D'Agriculture Pratique **4**:91-.
The effects of consuming bread made from Lathyrus cicera admixed with wheat flour are by judgement of the tribunal authentically constated [authentisch constatirt].
Source: ref ex Schuchardt (1885-87)
Lathyrus cicera bread toxicity/ France L. cicera toxicity/ Lathyrism France/ Lathyrus cicera/ Agriculture/ Bread/ Flour/ France/ Lathyrism Lathyrism L. cicera/ Lathyrus toxicity/ Toxicity L. cicera/ Toxicity/ Triticum aestivum.

Chevallier (1841). **Le lathyrisme**. Annales D'Hygiène **26**:126
Source: ref ex Selye (1957)
Lathyrism.

Pellicotti, T. and Pellicotti, N. (1847). **[Lathyrismus in den Abruzzen]**. Il Filatre Sebezio. Napoli.
30 cases of Lathyrism and malnutrition following the ingestion of Lathyrus.
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy/ Italy lathyrism/ History lathyrism/ Lathyrism history/ Famine/ Malnutrition/ History/ Italy/ Lathyrism.

Vilmorin (1847). **Note sur le danger de l'emploi dans le pain de la graine de jarosse**. Annales D'Hygiène Publ[Ique] **37** (74):467-469.
A case of Lathyrism in a 2o year old young man was observed in 1819 in the region of Bourgueil (Indre- et-Loire), France. Other cases of lathyrism were known to have occurred in the region.
Source: ref ex Schuchardt (1885-87)
Lathyrus/ Lathyrism history/ Lathyrism France/ France lathyrism/ Lathyrism epidemiology/ Lathyrus sativus/ Epidemiology lathyrism/ France History/ Lathyrism/ Humans/ Vilmorin.

Irving, J. (1857). The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta
Source: ref ex Jiménez Díaz (1941)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Irving, J. (1859). **Notice of a form of paralysis of the lower extremities, extensively prevailing in part of the district of Allahabad, produced by the use of Lathyrus sativus as an article of food**. The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta [Ann. Ind. Med. Sci.] **6**:424-.
Lathyrism. All cases occurred during the rainy season. More men than women and more poor than well off people were affected. Swampy ground appears to increase the toxicity of Lathyrus sativus seeds. This has also been reported by Laudon for L. cicera. Plants grown on [waterlogged] (sehr feucht: very moist) soils are more dangerous than those grown on dry ground.
Source: ref ex Schuchardt (1885-87)

Lathyrism India/ India lathyrism/ Waterlogging/ Environmental effects/ Toxicity/ Poverty/ Soil/ Lathyrus sativus/ Lathyrus cicera/ Environment Flooding/ Food/ India/ India L. sativus/ Lathyrism/ Lathyrism L. cicera/ Lathyrus toxicity/ Humans/ Paralysis/ Seed/ Toxicity L. cicera Toxicity L. sativus/ Water.

Kirk, K. (1859). **Topography of the Upper Sindu**. The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta [Ann. Ind. Med. Sci.] **6**:59-70.
Describes the paralysing properties of Lathyrus sativus in detail.
Source: ref ex Schuchardt (1885-87)
Lathyrus sativus toxicity/ India lathyrism/ Lathyrism India/ Symptoms lathyrism/ Toxicity L. sativus/ Farming systems/ Lathyrus sativus Agriculture/ Lathyrism symptoms/ Flooding/ India/ India L. sativus/ Lathyrism/ Lathyrus toxicity/ Toxicity/ Water.

Dufour, L. (1860). **[A case of Lathyrism caused by Lathyrus cicera in Algier]**. Recueil De Memoires De Med. Etc. Milit. Paris **3. Ser III**
Source: ref ex Schuchardt (1885-87)
Lathyrism/ Lathyrus cicera toxicity/ Toxicity L. cicera/ Lathyrism Algeria/ Algeria lathyrism/ Africa North lathyrism/ Lathyrism Africa North/ Lathyrus cicera/ Africa/ Algeria/ Lathyrism L. cicera/ Lathyrus toxicity/ North Africa/ Africa North/ Toxicity.

Irving, J. (1861). **Farther notice of paraplegia caused by the use of Kessaree dal (Lathyrus sativus) in Mirzpere district and another parts of India**. The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta **7**:501-
Source: ref ex Schuchardt (1885-87)
Lathyrism India/ India lathyrism/ Lathyrism history/ History lathyrism/ Lathyrus sativus/ Dhal/ History/ India/ India L. sativus/ Lathyrism Paraplegia.

Irving, J. (1861). **Report on a species of palsy prevalent in Pergunnah, Kirhagar [Kyshagur], in Zillah, Allahabad from the use of Lathyrus sativus or Kessaree dal, as an article of food**. The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta **7**:127-
Source: ref ex Schuchardt (1885-87)
Lathyrism India/ India lathyrism/ Lathyrus sativus/ Dhal/ Food/ India/ India L. sativus/ Lathyrism/ Prevalence/ Reports.

Luc (1862). **Gangrene spontanee de deux extremites inferieures, observee chez un arabe, et suivie de guerison sans amputation**. Recueil De Memoires De Med. Etc. Milit. Paris **3. ser. VIII**:52-56
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ Gangrene lathyrism/ Lathyrism/ Lathyrism gangrene/ North Africa/ Africa North.

Bertrand (1867). **Gangrene spontanee de deux membres inferieures; double amputation**. Recueil De Memoires De Med. Etc. Milit. Paris **3. Ser. XVIII**:330-
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Lathyrism gangrene/ Gangrene lathyrism/ Lathyrism symptoms/ Algeria/ Lathyrism/ North Africa/ Africa North/ Symptoms lathyrism.

Hattute (1868). **Des gangrenes spontanees chez les Kabyles**. Recueil De Memoires De Med. Etc. Milit. Paris **3. Ser. XXI**:518-531
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Lathyrus cicera toxicity/ Toxicity L. cicera/ Lathyrism gangrene/ Gangrene lathyrism/ Lathyrus cicera Algeria/ Lathyrism/ Lathyrism L. cicera/ Lathyrus toxicity/ North Africa/ Africa North/ Toxicity.

Irving, J. (1868). **Notice of paraplegia caused by the use of Lathyrus sativus in the various districts of the north-western provinces of India**. The Indian Annals of Medical Science, or Half-Yearly Journal of Practical Medicine and Surgery. Calcutta [Ann. Ind. Med. Sci.] **12**:89-124.
Questionnaire Survey on Lathyrism and its causes. Similar to the occurrence of beriberi, rainy season always correlated with the onset of lathyrism [D.E.: malnutrition?]. The relative immunity of women to the disease is remarkable.
Source: ref ex Schuchardt (1885-87)
Lathyrism India/ India lathyrism/ Famine/ Malnutrition/ Lathyrus sativus/ Beriberi/ Binding sites/ Immunity/ India/ India L. sativus/ India malnutrition/ Lathyrism/ Humans/ Paraplegia/ Surveys.

Pellicotti, N. (1869). **Sul latirismo alatus e sua nell'economia animale [Monograph on Lathyrus alatus and its detrimental effect on animal husbandry]**. Gionale Abruzzese Di Medicina e Chirurgia Pratica **4**:5-.
Pellicciotti [alternative spelling] date 1869 or 1879.
Source: ref ex Schuchardt (1885-87); Jiménez Díaz (1941)
Lathyrism/ Lathyrus alatus/ Toxicity/ Animal/ Economy/ Agriculture/ Lathyrism animals/ Lathyrus toxicity/ Monograph.

Cantani, A. (1873). **Latirismo (Lathyrismus) illustrata da tre casi clinici**. Il Morgagni **15**:745-765.
Arnoldo Cantani, a medical practioner from Naples, Italy, coined the term lathyrism.

Source: ref ex Selye (1957); Grmek (1980)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

Cantani, A. (1874). **Latirismo (Lathyrismus) illustrata de tre casi clinici**. Gaz Hebd De Méd **11**:170
Source: ref ex Selye (1957)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

Loudon (1880). **Loudon's Encyclopedia of plants**. London: Longmann's, Green & Co.
p. 620 Lathyrus. A name employed by Theophrastus to designate a leguminous plant. It is said by his commentator Bodaeus a Stapel, to have been derived from (la) an augmentative particle , and (thyros), any thing which is exciting; and to have been applied to this plant in consequence of certain aphrodisiacal qualities ascribed to it. L. sativus , Gesse fr. is frequently sown in Switzerland for soiling horses. In several parts of the continent, a white light pleasant bread is made from the flour of this pulse, but it produced such dreaded effects in the last century that the use of it was forbid by an edict of George, Duke of Würtemberg in 1671; and this not being observed was enforced by two other edicts under his successor Leopold, in 1706 and 1714 . Mixed with wheat flour in half the quantity, it makes a very good bread, that appears to be harmless. But bread made with this flour only has brought on a most surprising rigidity of the limbs in those who have used it for continuance; insomuch that the exterior muscles could not by any means be reduced, or have their natural action restored. These symptoms usually appeared on a sudden, without any previous pain; but sometimes they were preceded by a weakness and disagreeable sensation about the knees. Baths, both hot and cold, fomentations and ointments of various kinds have been tried without effect; insomuch that it is regarded as incurable, and neither very painful nor fatal, those who are seized with it usually submit to it with patience. Swine fattened with this meal lost the use of their limbs, but grew fat lying on the ground. A horse fed some months on the dried herb, was said to have its legs perfectly rigid. Kine [cattle] are reported to grow lean on it [cf. Allden and Geytenbeek, 1984], but sheep are not affected. Pigeons, especially young ones, lose the power of walking by feeding on the seed. Poultry will not readily touch it, but geese eat it without apparent damage. In some parts of Switzerland, cattle feed on the herb without harm. It would be worth inquiring, therefore, whether the soil may not contribute something to the ill qualities of the plant: and it is remarked that the seed from a strong, fat, moist soil, is much more deleterious than from a light one. (Duvernoy). Fabbrioni, from Florence, in 1786, says, that the government there has cautioned the peasants against the use of Lathyrus sativus; swine having lost the use of their limbs, and become pitiable monsters by being fed on this pulse exclusively. The peasants, however, eat it boiled, or mixed with wheat flour, in the quantity of one-fourth, without any harm. The poisonous Lathyrus from Barbary, is L. semine punctato of Casp. Bauhin, and seems to be only a variety, for in the crops of L. sativus in Italy, they find black seeds striped with white, as in the African seed. Fabbrioni suspects it to be a mule between L. sativus and L. cicera, for the flower and seed partake of the characters of both; having a black seed marked with white; and a white banner with a red keel to the corolla. (Fabbrioni's Letters in MSS. Banks). L. odoratus is one of our most esteemed border annuals, and is extensively grown in pots for decorating chambers and windows. L. tingitanus, articulatus, and annuus are also sown as border annuals. L. tuberosus produces tubers on the roots, like those of the earth nut (Bunium bulbocastanum); these are sold in the markets of Holland, like those of Orobus tuberosus and Trapa natans, and their flavour is highly esteemed. L. latifolius is a very showy plant for shrubberies, arbors and trellis work, and yields a great quantity both of green fodder and seeds, which some botanists have suggested might be applied to agricultural purposes. Ochrus(okros), yellow, in allusion to the colour of its flowers. plant with yellow flowers, native of hedges in the south of Europe.
Source: reprintDE
Pigs/ Pigeons/ Geese/ Human consumption/ Lathyrus/ Lathyrism history/ Vicia/ Pisum/ Hard to cook/ Grain legumes/ Theophrastus Aphrodisiac/ Poultry/ Switzerland/ Algeria/ Lathyrus semine punctato/ Lathyrus articulatus/ Lathyrus annuus/ Lathyrus tuberosus/ Lathyrus latifolius/ Pisum maritimum/ Vicia sylvatica/ Vicia cracca/ Vicia sativa/ Vicia narbonensis/ Vicia serratifolia/ Cultivation/ Germany/ Vicia sepium/ Vicia faba/ Environmental variation toxicity/ Ruminants/ Horticulture/ Forage/ Soil/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus ochrus Lathyrus tingitanus/ Lathyrus odoratus/ Cattle/ Horses/ Agriculture/ Lathyrism symptoms/ Agriculture history/ Bauhin/ Bees/ Bovine feed Brain/ Bread/ Cattle feed/ Cold/ Colour/ Corolla/ Entomology/ Environment/ Europe/ Fats/ Feed/ Feeding/ Feed ruminants/ Feed Vicia sativa Feed Lathyrus sativus/ Feed Lathyrus cicera/ Feed Lathyrus ochrus/ Feed Lathyrus tingitanus/ Flavour/ Flour/ Flowers/ Fodder/ Pulses/ History Horse diseases/ Horses lathyrism/ Horticulture L. odoratus/ Italy/ Italy L. sativus/ Italy lathyrism/ Lathyrism/ Lathyrism Algeria/ Lathyrism Germany/ Lathyrism horses/ Lathyrism Italy/ Lathyrism L. cicera/ Lathyrus toxicity/ Humans/ Intercropping/ Mixtures crops/ Muscles/ North Africa/ Africa North/ Ornamentals/ Ornamentals L. odoratus/ Orobus/ Pigs/ Roots/ Ruminant feed/ Ruminants L. sativus/ Seed/ Sensation Sheep/ Sheep feed/ Symptoms lathyrism/ Toxicity L. cicera/ Toxicity L. latifolius/ Toxicity L. odoratus/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Triticum aestivum/ reprint.

Brunelli, B. (1880a). **Due casi di paraplegia spastica**. Boll D R Accad Med Di Roma **6** (8):3-9.
Fed rabbits with the flour but these never lived long enough to develop any lesions.
Source: ref ex Schuchardt (1885-87)

Lathyrus cicera animal experiments/ Lathyrus cicera toxicity/ Bioassay rabbits/ Rabbit bioassay L cicera/ Lathyrism Italy/ Italy lathyrism Rodents/ Lathyrus cicera/ Bioassay/ Flour/ Italy/ Lathyrism/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrism L. cicera/ Lathyrus toxicity Paraplegia/ Rabbits/ Toxicity L. cicera/ Toxicity rodents bioassay/ Toxicity.

Brunelli, B. (1880b). **Due casi di paraplegia spastica**. Trans 7th Internat Med Congr, London **2**:45
Source: ref ex Selye (1957)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism/ Paraplegia.

Brounelli (1881). **Sur une cause peu connue de tabes dorsalis spasmodique**. Trans 7th Internat Med Congr, London **1**
Source: ref ex Jiménez Díaz (1941)
Lathyrism/ Lathyrism history/ History.

Bourlier, A. (1882). **Le lathyrisme**. Gaz Méd D'Algérie (Alger) [Alg Med] **17**:139-141.
Interesting presentation about Lathyrism at the Medical School Algiers (3. 7.1882). Competent treatment of the botany and clinical details. Animal experiments with extracts of Lathyrus cicera. Frogs and small birds died after two hours to 2 days. Paralysis of the legs was observed. Bourlier tends to think that lathyrism is caused by a disturbance of the posterior strands, in the posterior white and grey matter (in der weissen und grauen Substanz) and of a part of the side strands (Seitenstraenge) of the spine, analogous to the Tabes dorsalis spasmodica of Erb and Charcot.
Source: ref ex Selye (1957); Schuchardt (1885-87); Jiménez Díaz (1941)
Lathyrism/ Neurology/ Lathyrus cicera/ Bioassay/ Algeria/ Extraction/ Lathyrism Algeria/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrism L. cicera/ North Africa/ Africa North/ Paralysis/ Poultry/ Reptiles/ Spine.

Hamelin (1882). **Gesse**. Dictionnaire Encyclopedique Des Sciences Medicales. 48 Vol. Paris **44**:642.
Gives historical information and observations about animals (e.g. horses) being affected by Lathyrus consumption. Horses are affected through paralysis of the left nervus laryngeus.
Source: ref ex Schuchardt (1885-87)
Animals/ History/ Lathyrism/ Lathyrus spp toxicity/ Toxicity Lathyrus spp/ Lathyrus sativus history/ Lathyrism history/ France Lathyrus spp toxicity/ Lathyrism France/ France lathyrism/ Horses lathyrism/ Lathyrism horses/ Nervus laryngeus paralysis/ Paralysis left nervus laryngeus Larynx paralysis/ Paralysis larynx/ Lathyrus sativus/ Agriculture/ Agriculture history/ France/ Horse diseases/ Horses/ Larynx/ Lathyrism animals/ Lathyrus spp/ Lathyrus toxicity/ Nerves/ Neurology/ Paralysis/ Toxicity L. sativus/ Toxicity.

Astier, L. (1883). **Contribution a l'étude du lathyrisme: intoxication chronique par les gesses These No 163**. Lyon: Pitrat Aîné Ed.
Milk and meat seem to increase the toxicity of the Lathyrus flour. Astier carried out some animal experiments injecting Lathyrus seed extract subcutaneously. He observed inappetence, tremors followed by paralysis in a dog. He also managed to isolate a volatile toxic substance which he called lathyrine and attempted its chemical characterisation (D.E.: amine ?).
Source: ref ex Schuchardt (1885-87)
Lathyrism/ Lathyrus sativus toxicity/ Bioassay canine/ Canine bioassay/ Toxicity L. sativus/ Amines/ Lathyrus sativus/ Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Dogs/ Flour/ Injections/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrus toxicity/ Meat/ Milk/ Paralysis/ Seed/ Tingitanine/ Toxicity.

Bouchardt and Bourlier (1883). Progres Med **65**
Source: ref ex Jiménez Díaz (1941)
Lathyrism history/ History/ Lathyrism.

Bouley (1883). **Discussion sur le lathyrisme médullaire spasmodique**. Bull. Acad. De Med. (Paris) **12**:866.
see also Gabory, R. Discussion sur le lathyrisme medullaire spasmodique. Bull. Acad. De Med. (Paris). 1883; 12:871.
Source: ref ex Selye (1957)
Lathyrism.

De Renzi, E. (1883). **Sul latirismo**. Giorn. Internaz. D. Sci. Med. Napoli **N. S. V.**:777-780
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

Delafond (1883). Recueil De Medicine Veterinaire Pratique, Paris.
Animal poisonings caused by gesse (Lathyrus sativus).
Source: ref ex Schuchardt (1885-87)
Lathyrus sativus toxicity animals/ Lathyrism animals/ Animals L. sativus toxicity/ Toxicity L. sativus animals/ Lathyrus sativus/ Lathyrism Lathyrus toxicity/ Toxicity L. sativus/ Toxicity.

Gabory, R. (1883). **Discussion sur le lathyrisme medullaire spasmodique**. Bull. Acad. De Med. (Paris) **12**:871-.
see also Bouley. Discussion sur le lathyrisme médullaire spasmodique. Bull Acad Méd Paris. 1883; 12:866.
Source: ref ex Selye (1957)
Lathyrism.

Giorgini, F. (1883). **Due casi di Latirismo nella clinica di Parma**. Annal. Univ. Di Medic. e Cirug:263
Source: ref ex Jiménez Díaz (1941)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

Lunier (1883). **Discussion sur le lathyrisme medullaire spasmodique**. Bull. Acad. De Med. (Paris) **12**:909
Source: ref ex Selye (1957)
Lathyrism France/ France lathyrism/ France/ Lathyrism.

Marie, P. (1883). **Des manifestations médullaires de l'ergotisme et du lathyrisme**. Le Progres Médical **4**:64-66.
Subcutaneous injections of Lathyrus cicera extract did not produce the characteristic symptoms of lathyrism.
Source: reprintDE
Lathyrus cicera toxicity/ Lathyrism bioassay/ Bioassay L. cicera/ Lathyrus cicera/ Bioassay/ Lathyrism symptoms/ Injections/ Lathyrism/ Lathyrism L. cicera/ Lathyrus toxicity/ Symptoms lathyrism/ Toxicity L. cicera/ Toxicity/ reprint.

Marie, P. (1883). **Lathyrisme et Beriberi**. Le Progres Médical **XI**:842-845
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Reflexes/ Bouchard/ Beriberi/ Famine/ Malnutrition/ Algeria/ Lathyrism/ North Africa/ Africa North.

Proust, A. (1883). **Communication du Lathyrisme medullaire spasmodique**. Bull. Acad. De Med. (Paris) **2. Ser. Tom. 12**:829-853, 853-859, 866-875
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ Lathyrism/ North Africa/ Africa North.

Proust, A. (1883). **Discussion sur le Lathyrisme medullaire spasmodique et le Beriberi**. Bull. Acad. De Med. (Paris) **2. Ser. Tom. 12**:882-912, 916
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ Beriberi/ Binding sites/ Lathyrism/ North Africa/ Africa North.

Proust, A. (1883). **Rapport adresse a M. le Ministre du commerce sur une epidemie qui regne actuellement dans les montagnes de la Kabylie (Lathyrisme medullaire spasmodique)**. Recueil De Travaux Du Comite Consult. D'Hygiene Publ. De France **XIII**:184-205
Source: ref ex Schuchardt (1885-87)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ France/ Lathyrism/ Lathyrism France/ North Africa/ Africa North.

De Renzi, E. (1884). **Il latirismo e la paralisi spinale spastica**. Giorn. Di Neuropathol. Napoli **I.**:233-244
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

De Renzi, E. (1884). **Paralisi spinale spasmodico e latirismo**. Rivista Clinica D. Universita Di Napoli **V.**:49-
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy/ Italy lathyrism/ Italy/ Lathyrism.

Giglio, G. (1885). **Storia clinica d'un caso di latirismo in Sicilia. Palermo. octavo (15 pp.)**.
Source: ref ex Schuchardt (1885-87)
Lathyrism Italy Sicily/ Italy Sicily lathyrism/ Italy/ Italy lathyrism/ Italy Sicily/ Lathyrism/ Lathyrism Italy/ Sicily.

Schuchardt, B. (1885-1887). **Zur Geschichte und Casuistik des Lathyrismus**. Deutsches Archiv Fuer Klinische Medizin **40**:312-341.
A review of lahyrism. Several references to lathyrism in animals.
Source: reprintDE
Lathyrus magellanicus/ Lathyrus tuberosus/ Lathyrus articulatus/ Lathyrus aphaca/ Lathyrus pratensis/ Human consumption Lathyrus spp Lathyrus spp toxicity/ Lathyrism Lathyrus spp/ Vicia ervilia/ Vicia monantha/ Lathyrism review/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus ochrus/ Lathyrus clymenum/ Human consumption/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism L. cicera/ Lathyrism L. clymenum/ Lathyrus pratensis toxicity/ Lathyrus spp/ Lathyrus toxicity/ Humans/ Models/ Review/ Toxicity L. cicera/ Toxicity L. sativus Toxicity Lathyrus spp/ Toxicity/ Vicia/ reprint.

Huber, J. C. (1886). **Historische Notizen ueber den Lathyrismus**. Friedrich's Blaetter Fuer Gerichtliche Medizin **37** (1):34-36.

Alternative Journal title (Selye, 1957, spelling corrected according to Grmek, 1980) Friedrich's Blätter für gerichtliche Medizin Sanitätsp.
Source: ref ex Selye (1957); Grmek (1980)
Lathyrism history/ History/ Lathyrism/ Hippocrates.

Chabline and Semidoff (1892). Rev Med Russ
Source: ref ex Jiménez Díaz (1941)
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia.

Proust, A. (1893). **Du lathyrisme medullaire et spasmodique**. Bull. Acad. De Med. (Paris):829-859.
Gives a full details of a Lathyrism epidemic in Kabylia.
Source: ref ex Stockman (1931); Moya et al 1967
Lathyrism epidemiology Kabylia Algeria/ Algeria lathyrism/ Lathyrism Algeria/ Vicia ervilia/ Lathyrism/ Algeria/ Epidemiology lathyrism/ Lathyrism epidemiology/ North Africa/ Africa North/ Vicia.

Schabalin (1893). **Lathyrism in Russia**. Med. Obzor **4**
Source: ref ex Selye (1957)
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia.

Semidalov, V. (1893). **O Lathyrizme [On lathyrism]**. Medkoe. Obozr **39**:733-
Source: ref ex Tiwari (1994)
Lathyrism/ Lathyrism history/ History.

Abson (1894). **Lathyrism**. Veterinary Record:159
Source: ref ex Selye (1957) (read in abstract form only)
Lathyrism/ Lathyrism veterinary.

Kojewnikoff (1894). **Lathyrism in Russia**. Vestnik Psychiatr. [Vestrik Payole] **10**:2.
Alexis Yakovlievich Kozhevnikov, Russian neurologist and psychiatrist, born 1836, Ryazan; died January 10 23, 1902, Moscow.
The name has also been spelled Kochewnikow, Koschewnikoff, Koschewnikow, Kojewnikoff.
See also his publication: Latyrism - bolezn,obuslovennaia upotrebleniem v pyscu goroha lathyrus.Sankt Peterburg, 1894.
Source: ref ex Selye (1957) [Dwivedi]
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia.

Slidders (1894). **Lathyrism**. Veterinary Record:50
Source: ref ex Selye (1957)
Animal poisonings Lathyrus spp/ Lathyrism animals/ Animals lathyrism/ Lathyrism/ Lathyrism veterinary/ Lathyrus spp.

Grandjean, M. (1895). **Paralysie ataxique observee chez les kabyles a la suite de l'ingestion d'une variete de gesse (Lathyrus clymenum L., appelee en Kabylie: Habech)**. Arch. Med. Pharmacol. Militaires **1**:95-102
Algeria L. clymenum toxicity/ Lathyrus clymenum toxicity/ Lathyrism Algeria/ Lathyrism history/ Lathyrus clymenum/ Algeria/ History Lathyrism/ Lathyrism L. clymenum/ Lathyrus toxicity/ North Africa/ Africa North/ Toxicity.

Mingazzini, G. and Buglioni, G. B. (1896). **Studio clinico col anatomico sul latirismo**. Rev. Sperim. Freniatr. Med. Leg **22**:79-105
Source: ref ex Selye (1957); Jiménez Díaz (1941); Moya et al 1967
Lathyrism Italy/ Italy lathyrism/ Lathyrism history/ History/ Italy/ Lathyrism.

Goldzinger (1897). **Vortrag**. Klin. F. Nerv. Und Geistenk. [Klin. F. Nerven Und Geisteskrankheiten] **24** (4)
Source: ref ex Jiménez Díaz (1941)
Lathyrism history/ History/ Lathyrism.

Mirto (1897). **Lathyrism**. Il Pisano **18**:109-
Source: ref ex Selye (1957)
Lathyrism Italy/ Italy Lathyrism/ Italy/ Lathyrism.

Mirto (1898). **Sulla obtenzione degli elementi nervosi nel latirismo sperimentale**. Giron. Di Med. Legal **3**
Source: ref ex Jiménez Díaz (1941)
Lathyrism history/ History/ Lathyrism.

Blaise, H. (1899). **L'étiologie du lathyrisme médullaire spasmodique en Algérie**. Rev D'Hygiène:603-612
Source: ref ex Selye (1957)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ Lathyrism/ Lathyrism etiology/ North Africa/ Africa North.

Buchanan, W. J. (1899). **A note on lathyrism**. Journal OfTropical Medicine **1**:261
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Holzinger (1899). **Lathyrism in Russia**. Nevrol. Viestnik **7**:2
Source: ref ex Selye (1957)
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia.

Blaise, H. (1900). **L'étiologie du lathyrisme en Algérie**.
Source: ref ex Jiménez Díaz (1941)
Lathyrism Algeria/ Algeria lathyrism/ Algeria/ Lathyrism/ Lathyrism etiology/ North Africa/ Africa North.

Kobert, R. (1902). **Lehrbuch der Intoxikationen**. 2nd revised edn. ed., Stuttgart: Ferdinand Enke, Vol. Vol. 1 & 2. (author affiliation: Kaiserlich Russischer Staatsrat, Prof. & Dir. Inst. Pharmacol. & Physiol. Chem. University Rostock).
see Pammel (1911).
Source: reprintDE
Lathyrism history/ Lathyrus spp toxicity/ Vicia sativa/ Vicia ervilia toxicity/ History/ Lathyrism/ Lathyrus spp/ Lathyrus toxicity/ Toxicity Lathyrus spp/ Toxicity/ Vicia/ Vicia ervilia/ reprint.

Hendley (1903). **Lathyrism**. British Medical Journal **2**:707-709
Source: ref ex Selye (1957)
Lathyrism review/ Lathyrism/ Review.

Spirtoff (1903). **Lathyrism in Russia**. Obzor. Psych **5**:675-.
Spirtoff (1903) Lathyrism in Russia. Obosrenije Psych 5:675.
Source: ref ex Selye (1957)
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia.

Förster, O. H. (1911). **Resection of the posterior spinal nerve roots in the treatment of gastric crisis and spastic paralysis.** Proc. Roy. Soc. Med. **3**:226-254
Lathyrism treatment/ Treatment lathyrism.

Morgan, T. H. (1911). **Lathyrism**. Annals of the New York Academy of Sciences **21**:87-
Source: ref ex Selye (1957)
Lathyrism.

Pammel, L. H. (1911). **Manual of poisonous plants**. Cedar Rapids, Ia.: Torch Press.
He deals in greater detail with lathyrism, quoting a fair section from Kobert (1906) on the historical aspects and mentions that a 100 species of Lathyrus are distributed over North and South America. L. sylvestris is considered poisonous in its native home, the Carpathian mountains, but the cultivated type has been bred for lower levels of toxins [D.E. the seed contains Diamino butyric acid, DABA]. In the western U.S. the prairie vetchlings L. ornatus, L. polymorphus, and the marsh vetchling L. palustris are considered valuable forage plants, the latter forming an important part of the hay and adding materially to the feeding value. L. venosus and L. ochroleucus occurring in similar localities are much less valuable.
Source: reprintDE
Vicia/ Legume toxicity/ Review/ Vicism/ Toxicity/ Lathyrism/ Lathyrus toxicity/ America North poisonous plants/ Lathyrus ochroleucus Lathyrus venosus/ Lathyrus ornatus/ Lathyrus polymorphus/ Lathyrus palustris/ Lathyrus sylvestris/ Ruminants/ Antinutritional factors/ Forage DABA/ Cattle/ Hay/ Agriculture/ America/ Feeding/ Feed ruminants/ Feed Lathyrus ochrus/ Feed Lathyrus sylvestris/ History/ Lathyrism history/ Lathyrism review/ Lathyrus ochrus/ Lathyrus sylvestris/ North America/ Pigs/ Poisonous plants/ Ruminant feed/ Seed/ South America Toxicity L. sylvestris/ Toxin/ reprint.

Fumaroli and Zanelli (1914). **Anatomische experimentelle Forschungen ueber den Lathyrismus**. Archiv Fuer Psychiatrie Und Nervenkrankheiten **54** (2)
Source: ref ex Jiménez Díaz (1941)
Lathyrism anatomy/ Anatomy lathyrism/ Anatomy plant/ Lathyrism.

Stockman, R. (1917). **Lathyrism in man**. Edinburgh Medical Journal **19**:277-297
Source: reprintDE
Lathyrism/ Lathyrus sativus toxicity/ Lathyrus sativus/ Lathyrus toxicity/ Humans/ Toxicity L. sativus/ Toxicity/ reprint.

Turney, D. M.; Salmon, W. D., and Copeland, D. H. (1918). **Lathyrism**. Alabama Ext. Station, 54th and 55th Ann. Reports:18-.
Alternative citation [different year] Lathyrism in relation to the use of caley peas (Lathyrus hirsutus) for livestock.

Turney DM, Copeland DH, Salmon WD. Alabama Agr Exp Sta Annu Rept, Vol. 54-55, p. 18-19, 1943 [source: http://toxnet.nlm.nih.gov/]
also Alabama Agr Exp Sta Annu Rept, Vol. 56-57, p. 18-19, 1944 [source: http://toxnet.nlm.nih.gov/].
Source: ref ex Selye (1957)
Lathyrism review/ Alabama/ Alabama/ Lathyrism/ Reports/ Review.

Mirande, M. (1921). **Sur le lathyrism ou intoxication provoquée par les graines de Gesses**. Comp. Rend. Paris **172e**:1142-1143, 1202.
Anderson et al. : M. suggested that the toxicity of L. sativus was due to a protein which produces H2S when the crushed seed was allowed to undergo fermentation. Other species with H2S evolution during fermentation. L. odoratus, Phaseolus vulgaris, P. sativum, several species of Faba and Vicia, Cicer arietinum, Medicago sativa, and Lupinus albus.
Source: reprintDE
Sulfur/ Vicia/ Lathyrus/ ß-elimination/ Toxicity/ Lathyrus sativus/ Lathyrus odoratus/ Medicago sativa/ Cicer arietinum/ Evolution Fermentation/ Lathyrism/ Lathyrus toxicity/ Lupinus albus/ Medicago/ Phaseolus vulgaris/ Pisum sativum/ Protein/ Seed/ Toxicity L. odoratus Toxicity L. sativus/ reprint.

Acton, H. W. (1922). **An investigation into the causation of lathyrism in man**. Indian Medical Gazette **57**:241-247
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ India/ Lathyrism/ Humans.

Acton, H. W. and Chopra, R. N. (1922). **An investigation into the causation of lathyrism in man**. Indian Medical Gazette **57**:241-247
Source: ref ex Roy (pers. comm.)
Lathyrism India/ India lathyrism/ India/ Lathyrism/ Humans.

Acton, H. W. and Chopra, R. N. (1922). **The production and pharmacological action of kesari amine**. Indian Medical Gazette **57**:412-415.
Jiménez Díaz, C. (1941) cites Vol or issue 11.
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ Amines L sativus/ Lathyrus sativus amines/ Amines/ Lathyrus sativus/ India/ India L. sativus/ Khesari Lathyrism.

Vazeux (1923). **Nombreux cas d'empoisonment par la gesse clyméne (Lathyrus clymenum)**. Rev. Vet. Milit. B. Aires (Revista De Veterinaria Militar) **75**:481
Source: ref ex Selye (1957)
Lathyrus clymenum toxicity/ Lathyrism L. clymenum/ Lathyrus clymenum/ Lathyrism/ Lathyrus toxicity/ Toxicity.

Walker, W. H. (1924). **Observations on the feeding of horses on Lathyrus sativus**. Agr. J. India:646-648
Source: MWP_1992
Horse diseases/ Horses/ Horse poisoning L. sativus/ Horses lathyrism/ Lathyrism animals/ Lathyrism horses/ Feed/ Feed L. sativus/ Lathyrus sativus/ Lathyrus sativus animal feeding/ Lathyrus sativus India.

Anderson, L. A. P.; Howard, A., and Simonsen, J. L. (1925). **Studies on Lathyrism (I)**. Indian Journal of Medicine **12**:613-643.
Anderson et al. 1925 V. sativa var. angustifolia, a weed, known in Bihar as akta. Lathyrus sphoericus Retz., known as langra khesari, near Barail V. hirsuta Koch, known as misya and L. aphaca L., known as pipra. Evident unpalatability was noted with these weeds., daily food intake remained low, on average around the starvation level. Evolution of HCN from ordinary khesari grain (with other seeds admixed) was noted during experiments which aimed at repeating Mirande (1921) results on H2S evolution, which could not be confirmed. Review of vicine and vicianine(p 620). Ritthausen (1870, 1873, 1876, 1881, 1884, 1889) showed in a series of important papers that the seeds of Vicia sativa contained a nitrogenous glucoside to which he gave the name vicine and which was at first considered to be an alkaloid. In a number of investigations by Schulze & Trier (1910), Schulze (1911), Winterstein (1919), Johnson & Johns (1914), Fischer (1914), and more especially Levene (1914) and Levene & Senior (1916) the structure of divicine was studied. Immature seeds seem to contain the highest amount of vicine (Anderson et al. 1925). Experiments with ducks. Animals on germinated grain did not thrive as well as the others. All animals fed diets containing any quantity of V. sativa died within 6-25 days. A negative effect on feed intake was also noted for the V. sativa diets, but starvation was ruled out by a controlled starvation experiment. 50% V. sativa L. var. angustifolia induced poisoning in ducks and monkeys. Causal agent apparently not ascribed to any particular toxin. Symptoms: Ducks exhibited ataxy, walking in circles, convulsions, paresis, a kind of writhing contortion of the whole

body and death . Observation carried out over a period of 13-125 days. Post mortem: in almost every case examined cerebral congestion was a very-striking post mortem feature. Nothing remarkable about the abdominal or thoracic organs, except for an excess of pericardial fluid. 'On removing the skin of the head there was oedema and indication of haemorrhage over the surface of the skull. The brain superficially was intensely congested all over, pink in colour, and covered with dilated vessels. It was soft and difficult to remove. There was much hyperaemia about the cerebellum, medulla and upper cord, and blood welled up as soon as this part was laid open. Monkeys were less active, crouched in cages unable to sit up and constantly grinding their teeth. They exhibited fibrillary twitchings of the muscles of arms, legs and flanks, as well as violent convulsions of the whole body lasting 5-10 minutes. They also yawned frequently, were hyperexcitable and showed symptoms of paralysis. Quite a bit of detail about the symptoms of monkeys feeding on 15, 30 and 50% V. sativa diets, some of it in dhal form. These symptoms are different from those typical of lathyrism.
Source: reprintDE
Lathyrism/ Lathyrus sativus toxicity/ Oedema/ Haemorrhage/ Brain haemorrhage/ Vicia sativa/ Vicia sativa toxicity/ Vicia sativa ssp nigra toxicity/ Bioassay monkeys/ Bioassay ducks/ Ducks/ Primates/ Symptoms V sativa toxicity/ Neurology/ Lathyrus sativus/ Bioassay/ Agriculture Bihar/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Glycosides/ Glucosides/ Lathyrism symptoms/ Blood/ Brain/ Cerebellum/ Colour Convulsions/ Cyanides/ Dhal/ Diet/ Dietary intake/ Evolution/ Feed/ Feeding/ Feed intake/ Feed Vicia sativa/ Feed Lathyrus sativus/ Food Glucose/ HCN/ Immaturity/ India/ India Dietary/ Dietary/ India L. sativus/ India lathyrism/ India weed/ Intake/ Khesari/ Lathyrism animals Lathyrism Bioassay/ Lathyrism India/ Lathyrism review/ Lathyrus aphaca/ Lathyrus aphaca weed/ Lathyrus toxicity/ Medulla/ Muscles Paralysis/ Poultry/ Review/ Seed/ Skin/ Starvation/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Toxin/ Vicia Vicia hirsuta/ Vicine/ Weed/ Weed L. aphaca/ Weed V. sativa/ reprint.

Clough, G. W. (1925). **Lathyrism**. Veterinary Record **39**:839-840
Source: reprintDE
Lathyrus/ Toxin/ Lathyrism/ Lathyrism veterinary/ reprint.

Filiminoff, I. N. (1926). **Zur pathologisch-anatomischen Charakteristik des Lathyrismus**. Zeitschrift Fuer Die Gesamte Neurologie Und Psychiatrie **105** (1-2):76-92
Source: ref ex Selye (1957)
Lathyrism Russia/ Russia lathyrism/ Lathyrism/ Russia/ Pathology/ Anatomy.

Maleval, E. (1926). **Contribution a l'etude du lathyrisme. [Contribution to the study of lathyrism]**. Montpellier: 78 p.
Source: NAL CALL NO: 41.2 M29 ex. USDA NAL catalogue/telnet
Lathyrism history/ History lathyrism/ History/ Lathyrism/ USDA.

McCarrison, R. (1926). **A note on lathyrism in the Gilgit Agency**. Indian Journal of Medical Research **14** (2):379-381
Source: ref ex Steyn (1933)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Buchanan, A. (1927). **Report on Lathyrism in the Central Provinces: Nappur 1896-1902**. Raipur, India: Government Press.
Source: ref ex Dwivedi (1989)
Lathyrism India/ India lathyrism/ Lathyrus sativus/ India/ India L. sativus/ Lathyrism/ Reports.

MacKenzie, L. H. L. (1927). **Lathyrism in the Gilgit agency**. Indian Medical Gazette **62**:201-202
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Maleval, E. (1927). **Contribution à létude du lathyrisme chez le cheval et le mulet**. Revue Vétérinaire Et Journal De Mëdicine Vétérinaire Et De Zootechnie [Réunis] **79**:5-89.
This is a detailed paper which describes the symptoms and etiology of lathyrism in horses and mules. It also reviews the contradictory theories regarding lathyrism. The symptoms in equines differ from those observed in humans. Cornage = roaring ie. Constriction of the larynx (dyspnoea) in severe cases followed by asphyxiation are the characteristic feature. Mules are more susceptible than horses. The onset of symptoms can be delayed by two to three months following the cessation of feeding on Lathyrus sativus.
Gaget, Léger, Marcenac, Tasset observed walking difficulties without accompanying hoaring
Verrier reported walking difficulties accompanied with hoaring
Delafond, Barthélemy, Dard père, Maleval observed roaring without accompanying walking difficulties.
Citations are not given in this paper.
Source: reprintDE_2001
Lathyrism/ Lathyrism horses/ Horses lathyrism/ Lathyrism mules/ Mules lathyrism.

Megaw, J. W. D. and Gupta, J. C. (1927). **The geographical distribution of some of the diseases of India**. Indian Medical Gazette **62 (or 84)**:299-9 (or 468-472)
Source: ref ex Selye (1957) (or Dwivedi)
Lathyrism India/ India lathyrism/ Lathyrism epidemiology/ Distribution plants/ Epidemiology lathyrism/ Geography/ India/ Lathyrism.

Young, T. C. M. (1927). **A field survey [study] of lathyrism**. Indian Journal of Medical Research **15**:453-479.
Clear analysis of the neurological symptoms of Lathyrism.
Lathyrism etiology/ Lathyrism India/ India lathyrism/ Lathyrism symptoms/ India/ Lathyrism/ Surveys/ Symptoms lathyrism.

McCarrison, R. (1928). **Studies on lathyrism II**. Indian Journal of Medical Research **15** (2):797-800
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Stockman, R. (1929). **Lathyrism**. Journal of Pharmacology and Experimental Therapeutics **37**:43-53
Source: reprintDE
Lathyrism/ Lathyrus sativus toxicity/ Lathyrus sativus/ Lathyrus toxicity/ Toxicity L. sativus/ Toxicity/ reprint.

Petri, E. (1930). **Pathologische Anatomie und Histologie der Vergiftungen**. Berlin: Julius Springer (F. Henke, O. Lubarsch, eds.).
Source: ref ex Steyn (1933)
Lathyrus toxicity symptoms/ Vicia toxicity/ Lathyrism histology/ Lathyrism anatomy/ Lathyrism symptoms/ Anatomy plant/ Histology Histology lathyrism/ Lathyrism/ Lathyrus toxicity/ Symptoms lathyrism/ Toxicity/ Vicia.

Stott, H. (1930). **On the distribution of lathyrism in the United provinces and on its cause with a description of a 40 month feeding experiment in tonga ponies with botanically pure Lathyrus sativus and Vicia sativus**. Indian Journal of Medical Research **18**:51-55.
Stott, H. (1930) On the distribution of lathyrism in United Provinces and on its cause with a description of 4 3/4 months feeding experiment on ponies with botanically pur Lathyrus sativus and of Vicia sativa. Indian J Med Res 18:51-55.
Source: ref ex Selye (1957)
India lathyrism/ Lathyrism India/ Vicia sativa toxicity/ Lathyrus sativus toxicity/ Bioassays L. sativus/ Bioassays Vicia sativa/ Lathyrus sativus Feeding/ India/ India L. sativus/ Lathyrism/ Lathyrism Bioassay/ Lathyrus toxicity/ Toxicity L. sativus/ Toxicity/ Vicia/ Vicia sativa.

Stockman, R. (1931). **The poisonous principle of Lathyrus and some other leguminous seeds**. Journal of Hygiene **31**:550-562.
Amongst the grain legumes grown since antiquity for food and feed, bitter vetch (Vicia ervilia) and the vetchling (Lathyrus sativus, L. cicera, L. clymenum) are suspicious for their potential toxicity. Lathyrus has been noted for its toxicity to farm animals and humans especially since the 17th century. Bitter vetch is of limited importance as a cattle food. Lathyrus is extensively grown in France and Southern Europe, mainly as a fodder and to some extent also for human consumption. It is eaten by peasants as a pulse in cooked form and also, mixed with wheat flour, as bread. Therefore in times of scarcity and when the prices for cereals were high, its excessive use caused local outbreaks of poisoning. The grain (whole, ground, cooked in various ways) is the staple diet of large sections of the poorer classes in India and Kabylia (Algeria) Thus, during famines as a result of its increased consumption, pandemics have arisen. In India large sections of the agricultural population subsist on diets containing Lathyrus (khesari, teora, matra). In North-West and Central India, 6% of the population are affected by paralysis of the lower limbs, in the worst affected villages 10%+ of the male adults are affected. Cantani (Naples, 1873) named this disease, which was long well known to physicians in affected areas, Lathyrism. In Some Indian jails 4-6 ounces/person/day are fed without ill consequences (Buchanan). When used as the sole diet paralysis occurs within 4-8 weeks (Grandjean, etc.). The grain varies in toxicity, and toxicity seems to depend on the amount eaten and to some extent the individual's susceptibility. Men are more affected than women (10-12 male:1 female), boys more than girls. Slight cases manifest themselves as mild motor paralysis and spasticity in the lower limbs, which can disappear again. In more severe cases paralysis appears suddenly and can affect the bladder, rectum, genitals, with pains around the waist, lightning pains, loss of sensation, numbness, cramps, prickling. All symptoms clear up again, except for the paralysis which is permanent and can vary in its degree of severity. Chevallier (France, 1841) mentions somnolence (D.E.: inclination to sleep, sleepiness, drowsiness cf. with V. sativa and pigs). Brunelli (around Rome, ca.1880) reported 11 cases, a kind of transient intoxication was noted after each meal in some individuals. Desparanches (extensive epidemic around Blois, ca. 1829) noted that convulsive movements of the limbs were the earliest symptoms. McCombie Young (Ind. J. Med. Res., 1927,

15) gave a very detailed description of the symptoms. Proust (1883) Bull. Acad. Méd. 12, 829 gives full details of an epidemic in Kabylia. No post-mortem information was available (1931). With regard to the utilisation of the whole plant and its grain as animal fodder, 20% of the grain in diets is well known to be innocuous, except for horses which are particularly susceptible. On 100% grain diets, herbivores and pigs thrive and remain well, although they are apt to develop a weakness of their hindlegs (D.E. cf. Loudon, 1880). Pigs grazing on Lathyrus have not infrequently died of acute poisoning, and sheep and cattle have also died acutely. Ducks, geese and peacocks are readily poisoned by the grain, but pigeons, hens and partridges do well on them although perhaps they are not quite immune. Experiments with monkeys and frogs on various legumes, including Lens culinaris, Glycine max, L. sativus, L. cicera, V. ervilia are described and it is curious that nervous symptoms were observed in a monkey (3.5 kg bodyweight) feeding on a diet consisting of cooked Lens culinaris and orange juice (120g/day) (some milk and fruit were given in addition); it ate well, gained weight and died after 52 days after showing nervous symptoms. This sample of lentils seemed to have been more poisonous than L. sativus and degenerative changes in the brain and spinal cord were similar to those observed with Lathyrism The Dukes of Württemberg tried to ban Lathyrus from their domains. In India and Algeria similar attempts were made and proved unpopular and ineffective. Based on the assumption that Lathyrus is probably not more toxic than other grain legumes, Stockman suggests that a more varied and better balanced diet is the true preventive. Failing this, soaking the decorticated peas or the meal overnight in twice their weight of soft cold water and draining off the water with gentle pressure deprives them of a least one-quarter of the toxic substance. The cold water removes only very little protein and no starch. Undecorticated peas part with a mere fraction of the principle to cold water.
Source: reprintDE
Vicia ervilia toxicity/ Vicism/ Lathyrus toxicity/ Grain legumes/ Lens culinaris toxicity/ Lathyrism history/ Lathyrism review/ Ruminants Neurology/ Forage/ Grazing/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus clymenum/ Cattle/ Agriculture/ Lathyrism symptoms/ Algeria/ Bovine feed/ Brain/ Bread/ Cattle feed/ Cereals/ Cold/ Diet/ Ducks/ Europe/ Feed/ Feeding/ Feed ruminants/ Feed Lathyrus sativus/ Feed Lathyrus cicera/ Feed Lathyrus ochrus/ Female/ Flour/ Fodder/ Food/ France/ Geese/ Glycine max/ Pulses/ Grain legumes India/ Herbivory/ History Horse diseases/ Horses/ Horses lathyrism/ Human consumption/ Immunity/ India/ India Dietary/ Dietary/ India L. sativus/ India L. sativus consumption/ India lathyrism/ Khesari/ Lathyrism/ Lathyrism Algeria/ Lathyrism animals/ Lathyrism horses/ Lathyrism India/ Lathyrism L. cicera/ Lathyrism L. clymenum/ Lathyrus ochrus/ Lens culinaris/ Males/ Humans/ Milk/ Mixtures/ North Africa/ Africa North/ Paralysis/ Pigs Pigeons/ Population/ Poultry/ Primates/ Protein/ Reptiles/ Review/ Ruminant feed/ Ruminants L. sativus/ Seed/ Sensation/ Sheep/ Sheep feed Soaking/ Spasticity/ Spinal cord/ Susceptibility/ Symptoms lathyrism/ Toxicity L. cicera/ Toxicity L. sativus/ Toxicity L. sativus poultry Toxicity/ Triticum aestivum/ Utilisation/ Vicia/ Vicia ervilia/ Vicia sativa/ Water/ Whole plant/ reprint.

Trabaud; Murched-Khater; Chaty, and Mouharram (1932). **Le Lathyrisme en Syrie**. Bull. Acad. De Med. (Paris) **107**:260-
Source: ref ex Selye (1957)
Lathyrism Syria/ Lathyrism/ Syria/ Syria lathyrism.

Tranaid (1932). **[Lathyrus in Syria]**. Bull. Acad. De Med. (Paris) **107**:260-263
Source: ref ex Vet. Bull. 3, p 382 (1933) M. W. Perry
Syria/ Syria lathyrism/ Syria L. sativus/ Lathyrism Syria/ Lathyrus sativus Syria/ Feed/ Feed L. sativus/ Feed Lathyrus spp/ Toxicity/ Toxicity L. sativus.

Turegano, F. F. (1932). **La enfermedad de las 'guijas'. [The disease produced by Lathyrus]**. Agricultura, Madrid **4**:337-338.
Poisoning caused by the seeds of Lathyrus species is discussed from the veterinary point of view.
Source: HA 2: p. 209
Lathyrism Spain/ Spain lathyrism/ Lathyrus sativus Spain/ Lathyrus sativus/ Lathyrism/ Lathyrism veterinary/ Seed/ Spain/ Spain L. sativus.

Geiger, B. J.; Steenbock, H., and Parsons, H. T. (1933). **Lathyrism in the rat**. Journal of Nutrition **6**:427-442
Source: reprintDE
Rats/ Lathyrism/ Rodents/ Lathyrus odoratus/ Lathyrism nutrition/ Lathyrism rats/ Nutrition/ reprint.

Loisel, G. (1933). **Le lathyrisme syrien**. La Presse Medicale (7):149-150
Source: ref ex Zalkind 1937
Lathyrism Syria/ Syria lathyrism/ Lathyrism/ Syria.

Steyn, D. G. (1933). **Lathyrus sativus L. (chickling vetch, khesari, Indian pea) as a stockfood**. Onderstepoort Jour. Vet. Sci. and Anim. Indust **1**:163-171.
Lathyrus sativus forage feeding trials with cattle, sheep, horses and rabbits. Clear cases of toxicity were observed with the horses (n=2). week two: loss of condition, week three: Diarrhoea, dirty brown conjunctiva, week 4: in one horse progressive paralysis. Post Mortem: Abrasions on all prominent parts of the carcase; intense general icterus; hyperaemia of the lungs; subepicardial haemorrhages; pigmentation and degenerative changes in the liver; blood not coagulated and tarry in consistence; gastrophilus larvae in the stomach;

impaction of caecum, which contained a large amount oft of grit; chronic enteritis. Histology: no specific changes in the organs. liver and kidney showed hyperaemia. Death occurred in one horse after 35 days and ingestion of 114 kg of the forage (fresh weight). The other horse was fed for 55 days consuming 212 kg fresh forage developing similar symptoms. Lack of further L. sativus feed prompted discontinuation of the experiment and the animal recovered.
Source: reprintDE
Animal feeding/ Toxicity/ South Africa/ Rodents/ Ruminants/ Forage/ Lathyrus sativus/ Cattle/ Horses/ Agriculture/ Lathyrism symptoms Africa/ Blood/ Bovine feed/ Brain/ Cattle feed/ Feed/ Feeding/ Feed ruminants/ Feed Lathyrus sativus/ Feed Lathyrus ochrus/ Histology Histology lathyrism/ Horse diseases/ Horses lathyrism/ India/ India L. sativus/ India lathyrism/ Khesari/ Kidneys/ Lathyrism/ Lathyrism animals Lathyrism histology/ Lathyrism horses/ Lathyrism India/ Lathyrus ochrus/ Lathyrus toxicity/ Liver/ Paralysis/ Pigmentation/ Rabbits/ Ruminant feed/ Ruminants L. sativus/ Sheep/ Sheep feed/ Symptoms lathyrism/ Toxicity L. sativus/ reprint.

McCarrison, R. and Krishnan, B. H. (1934). **Lathyrism in the rat**. Indian Journal of Medical Research **22** (1):65-
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ Rodents/ India/ Lathyrism/ Lathyrism rats/ Rats.

Stockman, R. (1934). **The chemistry and pharmacology of Lathyrus peas**. Journal of Hygiene **34** (2):145-153
Source: HA 4: p. 236; reprintDE
Lathyrism/ Lathyrus sativus toxicity/ Chemistry/ Lathyrus sativus/ Lathyrus toxicity/ Toxicity L. sativus/ Toxicity/ reprint.

Chopra, R. N. (1935). **Lathyrism**. **The British encyclopedia of Medical Practice, London**, Vol. 7, p. 651.
Source: ref ex Selye (1957)
Lathyrism.

Zalkind, F. L. (1936). **[On the poisonous properties of Lathyrus sativus L., and of some other legumes]**. Trudy Po Prikladnoi Botanike, Genetike i Selektsii Ser. A **18**:51-63.
A critical review of the literature dealing with the experimental study of etiology of the poison induced by forms of Lathyrus and also by Vicia, Cajanus, Pisum, Ervum and other legumes.
Source: HA 6: p 217; reprintDE
Lathyrus toxicity review/ Lathyrism review/ Lathyrus sativus/ Cajanus/ Lathyrism/ Lathyrism etiology/ Lathyrus toxicity/ Pisum/ Poison Review/ Toxicity L. sativus/ Toxicity/ Vicia/ reprint.

Zagami, V. (1938). **A proposito del cosidetto latirismo**. Problem. Alimen **2**:29
Source: ref ex Jiménez Díaz (1941)
Lathyrism history/ History/ Lathyrism.

Hippocrates Epidemarum (ca. 460-ca. 377 B.C.) (1939). **The genuine works of Hippocrates/ translated from the Greek by Francis Adams**. Baltimore: Williams & Wilkins.
Citation provided by Dr. Ann Butler (pers. com.): Hippocrates Epidemarum [460 - 377 B. C.) Ed.3, vol. 5, book II, sect IV p. 126, Littree, Paris.
Lathyrism history/ Lathyrism antiquity/ History lathyrism/ History/ Lathyrism.

Shah, S. R. A. (1939). **A note on some cases of lathyrism in a Punjab village**. Indian Medical Gazette **74**:385-388
Source: ref ex Selye (1957)
Pakistan/ Lathyrism India/ Lathyrism Pakistan/ India/ India Punjab/ India lathyrism/ Lathyrism.

Steyn, D. G. (1939). **Poisonous stock feeds**. Fmg. S. Afr **14**:243-245.
Symptoms of poisoning resulting from feeding species of the following plants are noted: Lathyrus, Vicia, Glycine, Melilotus, Phaseolus, Medicago, Acacia etc.
Source: HA 9:1207
Toxicity legumes/ Legumes toxicity/ Lathyrus spp toxicity/ Lathyrism symptoms/ Acacia/ Feeding/ Glycine/ Lathyrism/ Lathyrus spp/ Lathyrus toxicity/ Medicago/ Melilotus/ Phaseolus/ Symptoms lathyrism/ Toxicity Lathyrus spp/ Toxicity/ Vicia.

Minchin, R. L. H. (1940). **Primary lateral sclerosis of South India. Lathyrism without Lathyrus**. British Medical Journal **1**:253-255
Source: ref ex Selye (1957), reprintDE
Lathyrism not L. sativus/ Lathyrus sativus/ India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism India/ reprint.

Semjonov (1940). **Las riquezas de la tierra**. E, Labor.
Source: ref ex Jiménez Díaz (1941)
Lathyrism history/ History/ Lathyrism.

Tel'tsov, A. I. (1940). **O gisto-patologicheskikh izemeniyakh v vozvratnykh i bluzhdayushchikh nervakh i myshtsakh gortani pri latirizme loshadei. {Lesions in the recurrent and vagus nerve at the larynx in Lathyrus sativus poisoning in horses]**. Svyet. Vet **11/12**:83-86.
T. studied the morphological changes of the vagus and recurrent nerves as well as alterations in the muscles of the larynx due to poisoning by Lathyrus sativus. Several photomicrographs illustrate the histological changes occurring in the affected tissues. The nerve fibres of the vagal nervous system undergo degenerative changes such as vacuolation, etc., particularly in the peripheral regions of the nerves. These changes, which develop quite irregularly, were specially marked in the preterminal sections of the left recurrent nerve. In the liver and spleen, a characteristic and profound inflammation of the tissues was observed. The history of the disease in a few horses is given in considerable detail. The poisonous elements in L. sativus appear to be produced by the plant in connection with a special type of soil, cultivation, and climatic conditions [E. R.P.].
Source: Veterinary Bulletin 14 (1944) p. 136
Lathyrism Russia/ Russia lathyrism/ Horses lathyrism symptoms/ Lathyrism horses/ Lathyrism histology/ Histology lathyrism/ Horses lathyrism case studies/ Case studies lathyrism/ Environmental variation toxicity/ Toxicity environmental effects/ Vagus nerve/ Larynx/ Spleen Inflammation/ Soil type/ Climate/ Cultivation/ Neurology/ Soil/ Lathyrus sativus/ Agriculture/ Lathyrism symptoms/ Environmental effects Environment/ Fibre/ Histology/ History/ Horse diseases/ Horses/ Horses lathyrism/ Lathyrism/ Lathyrism history/ Lathyrism veterinary Lathyrus toxicity/ Liver/ Muscles/ Nerves/ Nervous system/ Peripheral/ Russia/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity.

Beguiristain, J. (1941). **Sobre dos casos de latirismo**. Revista Clinica Espanola **2** (6):560-562
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Gonzalez Calvo, V. (1941). **Aportacion clinica al latirismo**. Revista Clinica Espanola **2** (6):558-560
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C. (1941). **Investigaciones sobre el latirismo. I. Introducion. Factores etiologicos**. Revista Clinica Espanola **3**:303-309
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C. (1941). **Latirismo y alimentacion (Editorial)**. Revista Clinica Espanola **2** (6):580-582.
Historical review of lathyrism. 22 ref.
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism review/ History/ Lathyrism/ Lathyrism history/ Review/ Spain/ reprint.

Ley, E. and Oliveras de la Riva, C. (1941). **Primera comunicacion sobre una epidemia de latirismo**. Revista Clinica Espanola **2** (6):533-541
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Aya Goni, A. (1942). **Dos paraplejias lateridicas.** Revista Clinica Espanola **6**(3):194-195
Lathyrism/ Spain/ Spain lathyrism/ Lathyrism Spain.

De Miquel, J. M. (1942). **Latirismo en Albacete**. Revista Clinica Espanola **7** (4):254-260
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C.; Roda, E.; Ortiz de Landazuri, E.; Marina, C., and Lorente, L. (1942). **Investigaciones sobre el latirismo. II. El cuadro clinico**. Revista Clinica Espanola **5**:168-177
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C. and Vivanco, F. (1942). **Estudios sobre el latirismo. III. Intentos de reproducir en los animales el latirismo por una dieta de harina de almortas (Lathyrus sativus)**. Revista Clinica Espanola **5**:234-241
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrus sativus animal feeding rats/ Cicer arietinum/ Rodents/ Lathyrus sativus/ Animal feeding/ Feeding Lathyrism/ Lathyrism animals/ Lathyrism rats/ Rats/ Spain/ Spain L. sativus/ reprint.

Jiménez Díaz, C. and Vivanco, F. (1942). **Estudios sobre el latirismo. IV. Investigaciones acerca del valor biologico de la almorta (Lathyrus sativus)**. Revista Clinica Espanola **5**:310-326
Source: reprintDE

Lathyrism Spain/ Spain lathyrism/ Lathyrus sativus biological value rats/ Rats/ Food value L. sativus/ Malnutrition L. sativus/ Rodents/ Famine Malnutrition/ Nutritional value/ Lathyrus sativus/ Food value/ Food/ Lathyrism/ Lathyrism rats/ Spain/ Spain L. sativus/ reprint.

Arigo Jiménez, J. (1943). **Un caso esporadico de latirismo**. Revista Clinica Espanola **8** (5):342-344
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Gonzalez Calvo, V. and Lopez de Letona, A. (1943). **Aspecto clinico de un nuevo foco de latirismo en Castilla**. Revista Clinica Espanola **9** (6):407-411
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C.; Ortiz de Landazuri, E., and Roda, E. (1943). **Estudios sobre latirismo. VI. Sínteso de datos clínicos y experimentales [para el conocimiento] de la patogenia del latirismo**. Revista Clinica Espanola **8**:154-167.
This synthesis paper contains maps depicting the areas of Lathyrus sativus cultivation in Spain and areas affected by lathyrism.
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrus sativus cultivation Spain/ Cultivation L. sativus Spain/ Lathyrus sativus/ Cultivation/ Lathyrism Maps/ Spain/ Spain L. sativus/ reprint.

Jiménez Díaz, C. and Romeo, J. M. (1943). **Estudios sobre el latirismo. VII. Influencia del factor hepatico sobre la absorcion de la albumina de la almorta**. Revista Clinica Espanola **8**:244-247
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Jiménez Díaz, C.; Vivanco, F., and Mendoza, H. C. (1943). **Estudios sobre el latirismo. V. Naturaleza de un cuadro neurologico que aparece en las ratas alimentados con garbanzos (cicerismo)**. Revista Clinica Espanola **8**:89-94
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism bioassay rats/ Rats/ Lathyrism Cicer arietinum (Cicerism)/ Rodents/ Bioassay/ Animal feeding Cicer arietinum/ Feeding/ Lathyrism/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrism rats/ Spain/ reprint.

Simarro Puig, J. and Roca de Vinals, R. (1943). **Aportacion a la anatomia patologica del latirismo (Una observacion anatomoclinica)**. Revista Clinica Espanola **8** (2):107-112
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism anatomy/ Anatomy plant/ Lathyrism/ Spain/ reprint.

Torres Canamares, F. and Vergara Olivas, A. (1943). **Nota sobre los latiricos de la provincia Cuenca**. Revista Clinica Espanola **8** (1):47-50
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Venkatachalam, V. (1943). **Common cattle poisoning**. Indian Farming **4**:571-575.
The toxic effects of the following plants are recorded: etc., kesari (Lathyrus sativus) which produced lathyrism, etc.
Source: HA 14:1589
Toxicity L. sativus/ Lathyrus sativus toxicity Ruminants/ Lathyrism/ Lathyrus sativus/ Cattle/ Agriculture/ India/ India L. sativus/ India lathyrism/ Khesari/ Lathyrism India/ Lathyrus toxicity/ Ruminants/ Ruminants L. sativus/ Toxicity L. sativus/ Toxicity.

Aldama Truchuelo, J. M. and Mateo Real, M. (1944). **Los factores muscular y constucional en le latirismo. Catorce casos de hombres en los que falta en absoluto el vello en torax y axilas**. Revista Clinica Espanola **13** (5):333-338
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Muscles/ Spain/ reprint.

Arigo Jiménez, J. (1944). **Los problemas clinico del latirismo**. Revista Clinica Espanola **14** (5):349.
Abstract only.
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Fernandez Noguera, J. and Mondejar, A. (1944). **Un caso de latirismo incipiente curado?** Medicina **no volume given**:625-628
Source: Moya et al 1967.

Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Treatment lathyrism/ Lathyrism treatment.

Morcillo Hervas, C. (1944). **Latirismo en Jaén**. Revista Clinica Espanola **12** (6):423-425
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain/ reprint.

Ortiz de Landazuri, E. (1944). **Estudios sobre el latirismo. VIII. Factores desencadentes y prorectores del latirismo**. Revista Clinica Espanola **XIV** (2):76-82.
In the presence of a protein poor diet (2000 kilo calories/day), 70 g Lathyrus sativus do not produce lathyrism. Up to 300 g of L. sativus can be consumed/day in the presence of protecting factors derived from better quality food (meat, cheese, milk) without provoking lathyrism. A higher dose of L. sativus leads to lathyrism even in the presence of protecting factors.
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Malnutrition lathyrism/ Famine/ Malnutrition/ Lathyrus sativus/ Diet/ Food/ Lathyrism/ Meat/ Milk/ Protein Quality/ Spain/ Spain L. sativus/ reprint.

Ranjan, M. P. (1944). **Lathyrism in India**. Antiseptic **41**:652
Source: ref ex Selye (1957)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Uruñuela, A. (1944). **El latirismo en Vizcaya**. Revista Clinica Espanola **14** (2):82-87.
87 cases of lathyrism in the province Vizcaya are reported and described in detail. The author believes that individuals who have eaten L. sativus for all their lives have become accustomed to some extent to the toxins in this diet and that fatigue may have become a dispositional factor. A sanitary classification of L. sativus types would be required as a basis for prophylaxis.
Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism predisposing factors/ Antinutritional factors/ Lathyrus sativus/ Diet/ Lathyrism/ Spain/ Spain L. sativus/ Toxin/ reprint.

Zubizarreta Aramburu, N. (1944). **Latirismo en Guipuzcoa**. Revista Clinica Espanola **15** (4):289-291
Source: reprintDE
Spain lathyrism/ Lathyrism Spain/ Lathyrism/ Spain/ reprint.

Shourie, K. L. (1945). **An outbreak of lathyrism in Central India**. Indian Journal of Medical Research **33**:239-247
Source: ref ex Selye (1957), reprintDE
Lathyrism India/ India lathyrism/ India/ Lathyrism/ reprint.

Aldama Truchuelo, J. M. and Mateo Real, M. (1946). **Un dato de interés en al patogenia del latirismo.** Anales Casa Salud Valdecilla **9**(3):179-181
Source: Moya et al 1967.
Lathyrism Spain/ Spain lathyrism/ Lathyrism/ Spain.

Jacoby, H. (1946). **Curative treatment of lathyrism, a disease of the nervous system**. Indian Medical Gazette **81**:246-247
Source: ref ex Selye (1957)
Lathyrism treatment/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Lathyrism treatment/ Nervous system/ Neurology.

Rudra, M. N. and Bhattacharya (1946). **Serum phosphatase in lathyrism**. The Lancet **1**:688
Source: ref ex Selye (1957)
Lathyrism serum biochemistry/ Enzymes serum phosphatase lathyrism/ Enzymes/ Lathyrism/ Lathyrism Biochemistry/ Lathyrism serum.

Ferro-Luzzi, G. (1947). **Malatia da 'Sebere' e lathyrismo in Eritrea**. Bulletino Della Societa Italiana Di Medicina e Igiene Tropicale **7**:483-493
Lathyrism Ethiopia/ Ethiopia lathyrism/ Ethiopia/ Lathyrism.

Jacoby, H. (1947). **Cause, symptoms and treatment of lathyrism. A specific nutritional neuropathy**. Indian Medical Gazette **82**:53-58
Source: ref ex Selye (1957)
Lathyrism treatment/ Lathyrism symptoms/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Lathyrism treatment/ Symptoms lathyrism.

Kessler, A. (1947). **Lathyrismus**. Monatsschrift Fuer Psychiatrie Und Neurologie **113**:345-376.
This paper describes the epidemic of lathyrism which affected the inmates of a German concentration camp in the Ukraine during WW 2. By taking Lathyrus sativus in a quantity of over 300 g/head/day, in the majority of

men a syndrome of signs arise (Lathyrism). Decrease of resistance through undernourishment (malnutrition), exhausting work and cold, as well as chronic disease (tuberculosis, diabetes) favour the onset of the disease and influence its course. The first symptoms of lathyrism are spasms in all muscular regions, and frequent imperative urinary desire. After about three months' ingestion, in a great deal of the patients, spastic paraparesis of the lower extremities appears that may progress to spastic paraplegia. In about 10%, seldom in the early stage, more frequently as late as 4-6 months after the beginning of Lathyrus consumption, vasomotor disturbances of circulation in the legs take place, giving rise to all degrees of anaemisation, from pallor with paroxysmal pains, local necroses up to ascending, symmetrical gangrene. The present observations have come out off a concentration camp on the Ukraine territory, occupied by German-Romanian troops. Of the 1350-1400 campmates, 60%, over 800, fell ill with lathyrism to varying degrees. The signs were reversible in light and medium- severe cases, capable of improving in severe ones. In 30 cases severe cases crippling by stabilised disorder of gait endured. Some patients retained scars after mutilation of deep necroses, and deformations through loss of gangrenous toes. 4 patients died, three of them of ascending symmetrical gangrene.(D.E. cf. Schuchardt's review of lathyrism, describing gangrene in some cases).
Source: reprintDE
Neurolathyrism/ Ukraine lathyrism/ Lathyrism Ukraine/ Forced labor camp/ Lathyrism clinical symptoms/ Lathyrism gangrene/ Spastic paraparesis/ Spastic paraplegia/ Lathyrism predisposing factors/ Neurology/ Famine/ Malnutrition/ Lathyrus sativus/ Lathyrism symptoms Syndrome/ cAMP/ Chronic disease/ Cold/ Diabetes/ Gait/ Gangrene lathyrism/ Germany/ Lathyrism/ Lathyrism review/ Humans/ Muscles Paraplegia/ Resistance/ Review/ Spasm/ Spasticity/ Symptoms lathyrism/ Ukraine/ reprint.

Lewis, H. B.; Fajans, R. S.; Esterer, M. B.; Shen, C.-W., and Oliphant, M. (1948). **The nutritive value of some legumes. Lathyrism in the rat. The sweet pea (Lathyrus odoratus), Lathyrus sativus, Lathyrus cicera and some other species of Lathyrus**. Journal of Nutrition **36**:537-559
Source: reprintDE
Vitamin C/ Lathyrus aphaca/ Lathyrus hirsutus/ Lathyrus sphaericus/ Lathyrus sylvestris/ Rodents/ Toxicity/ Nutritional value/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus clymenum/ Lathyrus tingitanus/ Lathyrus odoratus/ Ascorbic acid/ Lathyrism/ Lathyrism L. cicera/ Lathyrism L. clymenum/ Lathyrism nutrition/ Lathyrism rats/ Lathyrism vitamin C/ Lathyrus sylvestris/ Lathyrus toxicity/ Nutrition/ Rats/ Toxicity L. cicera/ Toxicity L. hirsutus/ Toxicity L. odoratus/ Toxicity L. sativus/ Toxicity L. sylvestris/ Vitamins/ reprint.

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Ortiz de Landazuri, E. and Galdo Seco, A. (1949). **Observaciones en equidos de la fase de intervalo entre la administration de una dieta latirogena y el comienzo de la enfermedad [Observations on Equidae of the interval between giving a diet that produces lathyrism and the appearance of the disease]**. Revista Clinica Espanola **32**:29-32.
An outbreak of lathyrism in horses in a province of Granada is reported. The animals had been fed for 97 days on a diet which included 2.6 kg blue vetch (D.E. comment: Lathyrus sativus) and 1 kg tares (yeros) [D.E. comment: Vicia ervilia] per head daily. Four days after discontinuing this diet, when the animals were receiving only barley and straw, the first case of lathyrism occurred. Eventually 15 of the 24 animals were affected, and the mortality was 25 per cent. The last case occurred 50 days after the vetch diet was discontinued. Hybrids seemed most susceptible to the disease. 14 of 16 mules being affected, but only 1 of 7 mares.
Source: The Veterinary Bulletin 1950(20) p 226 [original source Nutr. Abstr. Rev. 19, 496 (1949)]
Lathyrism Spain/ Spain lathyrism/ Lathyrus sativus/ Diet/ Feed/ Lathyrism/ Spain/ Spain L. sativus/ Vicia ervilia/ Horses/ Equidae/ Lathyrism horses/ Horses lathyrism/ Synergy Lathyrus sativus - Vicia ervilia.

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Source: ref ex Foury (1954)
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Source: reprintDE
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Lathyrus tingitanus indigenous to North Africa was recommended by Dr. Trabut, Algeria. Introduced to USA about 1900 as chicharaca, it was found to be more resistant to frost and drought than field peas, sweet clover (Melilotus) or vetches (Vicia spp., V. sativa etc.). It has been grown successfully on poor, sandy soil at a temperature as low as -7 deg C. In parts of Australia where annual rainfall is 16 in. L. tingitanus takes from 6 to 7 months to mature. Early autumn sowing in land prepared as for cereals is best. Seed rates from 8 to 30 lb. per acre are quoted. The seed can be broadcast, drilled or sown from a combine drill with 1 to 1.5 cwt. superphosphate per acre. Inoculation is recommended in the absence of suitable Rhizobia. A mixture of 5 to 8 lb. of Tangier pea sown with 1 bu. of oats per acre is said to make an excellent hay or silage crop. Although the forage of this pea is nutritious and highly palatable to stock, there is evidence from America that its seeds contain a toxic substance which can cause lathyrism in rats (Cf. Lewis et al. 1948). If tangier pea is grown for seed, the haulms left after threshing compare favourably with oat and bean straw. When chaffed and moistened they are relished by stock. Tangier pea can also be used as a green manure crop.
Forage L. tingitanus/ Mixtures L. tingitanus/ Lathyrus tingitanus toxicity/ Lathyrus tingitanus cultivation/ Agronomy L. tingitanus/ Rodents L. tingitanus toxicity/ Intercropping/ Forage/ Soil/ Lathyrus tingitanus/ Hay/ Straw/ Agriculture/ Green manure/ Africa/ Algeria/ Agronomy mixtures/ America/ Australia/ Cereals/ Climate/ Cold/ Cultivation/ Drought/ Fermentation/ Forage Australia/ Frosts/ Inoculation/ Lathyrism Algeria/ Lathyrism rats/ Lathyrus toxicity/ Manures/ Melilotus/ Mixtures crops/ North Africa/ Africa North/ Avena sativa/ Rats/ Resistance Rodents/ Sand/ Sandy Soil/ Seed/ Seeding/ Silage/ Soil sandy/ Temperature/ Toxicity/ USA/ Vicia spp/ Vicia/ Vicia sativa.

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Source: ref ex Selye (1957)
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Source: reprintDE
Lathyrism Spain/ Spain lathyrism/ Lathyrism genetic susceptibility/ Toxicity/ Lathyrus sativus/ Deficiency/ Enzymes/ Lathyrism/ Lathyrus toxicity/ Spain/ Spain L. sativus/ Susceptibility/ Toxicity L. sativus/ reprint.

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Source: HA 36:762
Review Lathyrism literature/ Forage chemical composition review/ Forage digestibility/ Nutritional value/ Antinutritional factors/ Forage Lathyrus sativus/ Chemical composition/ Digestibility/ Energy/ Forage chemical composition/ Lathyrism/ Lathyrism review/ Review/ Toxin.

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Source: reprintDE
NPAA/ Lathyrine isolation/ NPAA Rodents/ Tingitanine/ Lathyrus tingitanus/ Lathyrism symptoms/ Amino acids/ Ecology/ Isolation Lathyrism/ Lathyrism rats/ Lathyrus toxicity/ Mice/ NPAA/ Poultry/ Rats/ Rodents/ Seed/ Symptoms lathyrism/ Systematics/ Toxicity/ reprint.

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Ganglia Spinal pathology/ Microscopy/ Neurologic Manifestations/ Rats/ Central Nervous system diseases pathology/ Cyanides poisoning Lathyrism pathology/ Rodents/ Neurology/ Central Nervous system/ Ganglia/ HCN/ Lathyrism/ Lathyrism Anatomy/ Lathyrism rats/ Nervous system/ Neurolathyrism/ Spinal cord/ Nervous system diseases.

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Source: Medline (66-69) 66050196
Spain/ Mice/ Alopecia etiology/ Brain Diseases etiology/ Lathyrism pathology/ Rodents/ Neurology/ Lathyrus sativus/ Alopecia/ Brain/ Brain diseases/ Flour/ Lathyrism/ Lathyrism etiology/ Lathyrism Spain/ Spain L. sativus.

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In the film 'Ashes' [English title] by Andrzej Wajda based on the novel 'Lost army' [English title] by Stephen Zeromsky spanning the period 1798-1812, a horse is poisened by grain from a Spanish village. The footage of the horse losing control of its hindlegs and falling down a steep cliff is very graphic. This black and white film was broadcast by the Australian channel SBS on the 2.6.1996 at 0.30 am. Distributor of the film is Atlas International in Munich, Germany Ph: 89227525, Fax: 89224332. Inclusion of this item in the bibliography aims to draw attention to the visual media as potential sources of illustrative material and knowledge about lathyrism.
Lathyrism history/ History lathyrism/ Cinema/ Film/ Visual media/ Horses/ Horses lathyrism/ Lathyrism Spain/ Spain lathyrism/ Lathyrism Spain.

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Semistarvation ?lathyrism/ Lathyrism fasting rats/ Lathyrism periosteum surgery/ Rodents/ Lathyrism/ Lathyrism rats/ Rats.

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Source: Medline 76274380; Reprinted with permission Copyright 1976 Springer Verlag
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Source: Medline 78051413
Lathyrism Aged/ Lathyrism hippocampus pathology/ Lathyrism etiology/ Lathyrism medulla oblongata pathology/ Lathyrism motor Neurons pathology/ Lathyrism nerve degeneration/ Lathyrism pyramidal tracts pathology/ Lathyrism central Nervous system pathology/ Lathyrism pathology/ Neurology/ Lathyrus sativus/ Axons/ Lathyrism symptoms/ Age/ Anterior horn/ Central Nervous system/ Chickens/ Diet Hippocampus/ Lathyrism/ Lathyrism hippocampus/ Humans/ Medulla/ Motor neurons/ Myelin/ Nerves/ Nervous system/ Neurolathyrism Neurons/ Nuclei/ Pyramidal tract/ Spasticity/ Spastic paraparesis/ Spinal cord/ Symptoms lathyrism.

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Lathyrism India/ Lathyrism diagnosis/ Lathyrism therapy/ Lathyrism epidemiology/ Lathyrus sativus toxicity/ Lathyrus sativus/ Lathyrism symptoms/ Diagnosis/ Epidemiology lathyrism/ India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrus toxicity/ Symptoms lathyrism Toxicity L. sativus/ Toxicity/ reprint.

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Source: Medline 79053352
Aged/ Chronic Disease/ Middle Age/ Paralysis immunology/ HLA Antigens/ Lathyrism immunology/ Muscle Spasticity immunology Neurology/ Age/ Antigens/ HLA/ Immunology/ India/ India lathyrism/ Lathyrism/ Lathyrism Aged/ Lathyrism India/ Muscles/ Muscle spasticity/ Neurolathyrism/ Paralysis/ Spasticity.

Deshmukh, P. and Taylor, J. J. (1978). **Neurofibrillary tangles in experimental neurolathyrism in rats induced by imino dipropionitrile (IDPN). 1. Fine structural changes in the spinal cord and dorsal root ganglia.** Acta Neuropathol Berl **41** (1):17-22
Anterior horns of the spinal cord from cervical and lumbar regions and dorsal root ganglia from these same levels were studied for ultrastructural changes in imino-dipropionitrile (IDPN) treated rats. Normal saline-injected rats, treated identically, served as controls for this study. In the spinal cord axonal balloons or dystrophic axons appeared in lightly myelinated or unmyelinated axons within 24 h after the third injection of IDPN. At this time hind leg paralysis had not yet developed. In addition to axonal changes, a few dendrites also showed neurofibrillary degeneration. Central chromatolytic changes were observed in most of the neurons, with evidence of generalised oedema present within the cord. In the dorsal root ganglia axonal balloons were very prominent and showed neurofibrillary hypertrophy. Neurofibrillary material was also noted in the perikarya of medium-sized ganglion cells.
Source: Medline 78141459; Reprinted with permission Copyright 1978 Springer Verlag
Dendrites/ Edema/ Hypertrophy/ Lathyrism etiology/ Microscopy Electron/ Nervous system diseases chemically induced/ Neurofibrils/ Nitriles Rats/ Time Factors/ Ganglia Spinal pathology/ Lathyrism pathology/ Nervous system diseases pathology/ Spinal Cord pathology/ Rodents Neurology/ Axons/ Ganglia/ Injections/ Lathyrism/ Lathyrism rats/ Microscopy/ Nervous system/ Neurolathyrism/ Neurons/ Oedema/ Paralysis Roots/ Spinal cord/ Nervous system diseases.

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Ethiopia lathyrism/ Lathyrism Ethiopia/ Neurology/ Ethiopia/ Lathyrism/ Lathyrism review/ Neurolathyrism/ Reports/ Review.

Hamilton, D. (1978). **Some experience with paraplegia in a small hospital in Nepal.** Paraplegia **15** (4):293-301
Paraplegia is a common problem in developing countries. They are the most pitiable group of cases seen, but they can all be offered some help, however limited one's resources. The main causes are Potts Disease, arachnoiditis, tropical spastic paraplegia, trauma, lathyrism and cord compression. The usual trauma is falling from trees and the use of trained monkeys to gather leaves and nuts whilst humorous should not be dismissed. The author saw some 35 cases of paraplegia, of which four are described--two good results and two bad. The physician going to a developing country is advised to prepare himself for the care of these cases and to be prepared to motivate staff, patients and relatives. He will find local medical assistants are kind and enthusiastic and rapidly acquire the necessary skills. Nearly all cases should receive a simple and inexpensive anti-tuberculous regime, vitamins and a very generous diet. Necessary equipment required for the home should be locally made and nothing requiring more than simple maintenance should be used.
Source: Medline 78115080; Reprinted with permission. Copyright (1978) Stockton Press
Adult/ Child/ Nepal/ Paraplegia etiology/ Paraplegia therapy/ Diet/ Lathyrism/ Lathyrism etiology/ Lathyrism therapy/ Leaves/ Humans Paraplegia/ Primates/ Spasticity/ Spastic paraplegia/ Tropics/ Vitamins.

López Aydillo, N. R. and Ramirez Gomez, C. (1978). **II. Probable etiologia de la alopecia en los enfermos latiricos espanoles. Resultado de la investigacion de toxinas en los hongos que se desarrollan en la superficie externa de las semillas del 'Lathyrus sativus' (almortas). [II. Probable etiology of alopecia in the Spanish lathyric patients. Results of study of toxins in fungi that develop in the external surface of the seeds of Lathyrus sativus].** Arch. Neurobiol. Madr **41** (6):461-486
Source: Medline 79081526, reprintDE
Aflatoxins analysis L. sativus/ Microbiology L. sativus/ Legumes toxins/ Mice/ Penicillium isolation and purification/ Pruritus chemically induced/ Seed/ Alopecia chemically induced/ Food Contamination mycotoxins/ Lathyrism complications/ Spain lathyrism/ Lathyrism Spain Rodents/ Antinutritional factors/ Lathyrus sativus/ Mycotoxins/ Aflatoxins/ Alopecia/ Contamination/ Food contamination/ Food/ Fungi Mycology/ Isolation/ Lathyrism/ Lathyrism etiology/ Lathyrism mycotoxins/ Microbiology/ Penicillium/ Purification/ Spain/ Spain L. sativus Toxin/ reprint.

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Lathyrus sativus toxicity/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Agriculture/ Toxicity/ India/ India L. sativus/ Lathyrism/ Lathyrus toxicity/ Reports/ Seed/ Toxicity L. sativus.

Somogyi, J. C. (1978). **Natural toxic substances in food.** World Review of Nutrition and Dietetics **29**:42-59
Source: Medline 78206461
Cinnamates pharmacology/ Favism etiology/ Lathyrism etiology/ Phenols pharmacology/ Thiamine antagonists and inhibitors/ Toxin analysis Food Analysis/ Antinutritional factors/ Favism/ Food/ Lathyrism/ Lathyrism nutrition/ Lathyrism review/ Nutrition/ Phenols/ Review/ Thiamine Toxic substances/ Toxin.

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Lathyrism etiology/ Legumes poisoning/ Neurology/ Chickens/ Lathyrism/ Neurolathyrism.

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Source: Medline 80138242
Biological Availability/ Cyanides/ Dietary Proteins/ Favism etiology/ Lathyrism etiology/ Lectin/ Plants Toxic/ Thyroid Antagonists/ Legumes Nutrition/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Diet/ Favism/ Food/ Glycine max/ HCN/ Dietary/ Lathyrism/ Lathyrism nutrition/ Humans/ Protein.

Mehta, T.; Zarghami, N. S.; Parker, A. J.; Cusick, P. K., and Haskell, B. E. (1979). **Neurotoxicity of orally or intraperitoneally administered L-3-oxalyamino-2-aminopropionic acid in the mouse**. Toxicology and Applied Pharmacology **48**:1-9
ODAP oral toxicity/ Bioassay mouse/ Rodents/ ODAP intraperitoneal toxicity/ Lathyrism ODAP toxicity/ Neurology/ Bioassay/ Lathyrism Lathyrism Bioassay/ Mice/ Neurotoxicity/ ODAP/ Toxicity ODAP/ Toxicity rodents bioassay/ Toxicity.

Bhat, R. V. and Krishnamachari, K. A. V. R. (1980). **Social management of lathyrism and venoocclusive disease in Madhya Pradesh**. Hyderabad, India: Food and Drug Toxicology Research Centre.
Source: ref ex Kaul et al. (1989)
Lathyrism prevention/ Lathyrism India/ India lathyrism/ Lathyrism socioeconomics/ Socioeconomics lathyrism/ Economics/ Drugs/ Food/ India India Madhya Pradesh/ Lathyrism/ Lathyrism economics/ Madhya Pradesh/ Management/ Prevention lathyrism.

Bhuiyan, A. Q. and Sarker, P. C. (1980). **Socio-economic conditions of lathyrism-affected families in Rajshashi and Kushtia districts**. Rajshahi: Shaw Unnayan.
Source: ref ex Kaul et al. (1989); NAL Call No RA1242 L35B48 1980
Lathyrism socioeconomics/ Socioeconomics lathyrism/ Bangladesh lathyrism/ Lathyrism Bangladesh/ Economics/ Bangladesh/ Lathyrism Lathyrism economics.

Borg, J.; Bakri, S., and Mazars, G. (1980). **A propos de la neurotoxicité de *Lathyrus sativus* L., plante alimentaire et médicinale de l'Inde**. Actes du Colloque sur les médicines traditionelles de l'Asie, in Paris. Published in Strasbourg.
Source: Grmek (1980)
Lathyrism/ Lathyrism India/ India lathyrism/ History lathyrism/ Lathyrism history/ Lathyrus sativus/ Medicinal properties/ Tradtional medicine.

Grmek, M. D. (1980). **La légende et la réalité de la nocivité des fèves [Legend and reality in relation to the toxicity of Vicia faba].** Pubbl. Stn. Zool. Napoli. II **2** (1):61-121 (author affiliation: Ëcole Partique de Hautes Etudes, 22, rue des Ëcoles, 75005 Paris, France)
[French] This paper reviews in detail the classical, historical, esoteric and scientific literature related to Favism and the Pythagoraean ban on Vicia faba (kúamon apéchesthai - abstine from faba beans). It is an excellent source of citations. On pp. 80-87 a section titled "Aveuglement prudent des médicins et constat hippocratique du lathyrisme" lathyrism is discussed. P. 83 Citation of a passage from Hippocrates Epidemics [epédemies, livre II, répété dans livre VI; book II, repated in Book IV] A Ainos, lors d'une famine, ceux qui mangeainet continuellement des légumineuses devinrent impotens des membres inférieurs; cela persista; de plus, ceux qui mangeaient de l'ers eurent douleur aux genoux [Epid. II 4,3 (Littré V 126) et Epid. VI 4, 11 (Littré V 310) ; translation differs sensibly from that of Littré]. Translated into English this reads: During famine at Ainos those who continuously ate legumes developed impotence of the lower limbs. This persisted. Others, who ate Vicia ervilia suffered pain in their knees." Ainos was a village in Thrace, the epidemic [dated to the last decade of the 5th century B.C. or first part of 4th century ; Grmek, M.D. (1980) La description hippocratique de la toux épidémique de Périnthe. Hippocratica, Paris pp. 199-221 [particularly pp.211-216]] was associated with war and economic deterioration [May, J.M.F (1950) Ainos, its history and coinage, Oxford, Oxford University Press]. Two terms are used in the greek text. Orobophagéontes and

ospriophagéontes [Orobos eaters, ospria eaters]. Galen in his commentary of Hippocrates [Galen, In Hippocratis libros I et II Epidemiarum commentaria. ; the famine in Ainos is not known in arabic translations, see Wenkebach, E. and Pfaff, F. (1934) Corpus Medicorum Graecorum V 10, 1, Leizpig and Berlin, Teubner] interpreted ospria as legumes which are not habitually used for the preparation of bread. Orobos = Vicia ervilia Willd. [used by Theophasrus and Dioscorides]. The symptom of knee pain is too general to allow any valuable conclusions regarding its etiology. A definite paraplegia following the ingestion of legumes, however, can be attributed retrospectively to the consumption of Lathyrus spp. [L. sativus, L. cicera, [D.E. addendum L. clymenum]. The use of Lathyrus sativus as food in the graeco-roman world (André, 1961, p.38) is also attested by the comic poets [Anaxandrides, frgm. 41, 43; Alexis, frgm. 162, 12].
Source: reprintDE_2001
Greece/ History of Medicine/ Ancient History/ Human/ Rome/ Favism/ Legumes/ adverse/ effects/ Vicia/ V. faba/ Lathyrism/ Vicia ervilia Lathyrus sativus/ Dioscorides/ Hippocrates.

Gupta, Y. P. (1980). **Khesari Dal consumption- A health hazard**. Indian Farming, Vol. 30, pp. 7-9.
Lathyrus sativus toxicity/ Lathyrism India/ India lathyrism/ Lathyrus sativus human consumption/ Human consumption L. sativus/ Lathyrus sativus/ Dhal/ Human consumption/ India/ India L. sativus/ India L. sativus consumption/ Khesari/ Lathyrism/ Lathyrus toxicity/ Humans Toxicity L. sativus/ Toxicity.

Librach, I. M. (1980). **Lathyrism.** Br J Clin Pract **43** (4):118-120
Source: Medline 80242455
Middle Age/ Paraplegia etiology/ Lathyrism complications/ Age/ Lathyrism/ Lathyrism etiology/ Paraplegia.

Padmanaban, G. (1980). **Lathyrogens**. [Chap 8 in] Liener, I. E. (Ed). **Toxic constituents of Plant foodstuffs**, 2nd. edn. ed., N.Y.: Academic Press, pp. 239-261.
Source: reprintDE
Lathyrus sativus toxicity/ Lathyrism review/ NPAA review/ Legume toxins/ Review/ Antinutritional factors/ Lathyrus sativus/ Lathyrism Lathyrogens/ Lathyrus toxicity/ NPAA/ Toxicity L. sativus/ Toxicity/ Toxin/ reprint.

Schneider, G.; Ruther, W.; Klapproth, A., and Schott, K. J. (1980). **Untersuchungen ueber die Wirkung der 'neurolathyrogenen' Substanz beta,beta'-Iminodipropionitril auf den Salzkrebs Artermia salina. [Studies on the effect of the neurolathyrogenic substance beta,betaiminodipropionitrile on the branchiopod Artemia salina].** Arzneimittelforschung **30** (4):592-593
beta,beta'-Iminodipropionitrile (IDPN) is a neurotoxic substance, which induces choreiform movements for life in rats and mice. As for the phenotype this seems to be a suitable animal model for the comparison with Huntington's chorea in man. In our experiments we have tested the effect of IDPN on different developmental stages of the branchiopode Artemia salina. One-day old nauplii show the strongest reaction to the substance. As little as 10(-5) g IDPN/l culture medium induces in one-day old nauplii a characteristically altered swimming behaviour. This behavioural response of the one-day old nauplii may possibly serve as a basis for a simple qualitative biological assay for the detection of IDPN or its effective metabolite, respectively.
Source: Medline 80242171
Aging/ Behaviour Animal drug effects/ Chemistry/ Mice/ Rabbits/ Swimming/ Artemia salina drug effects/ Lathyrism chemically induced Nervous system drug effects/ Nitriles pharmacology/ Rodents/ Bioassay nauplii swimming behaviour (Artemia salina)/ Neurology/ Bioassay Chorea/ Drugs/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrism rats/ Humans/ Models/ Nervous system/ Neurotoxins/ Nitriles/ Rats.

Sharma, N. K.; Jain, M. K.; Khanijo, S. K., and Choudhary, R. N. (1980). **A study of paraplegia. Lathyrism. Clinal profile (Thesis)**. Rewa: University of Rewa.
Lathyrism symptoms/ Lathyrism India/ Lathyrism symptoms/ India/ India lathyrism/ Lathyrism/ Paraplegia/ Symptoms lathyrism.

Weintroub, S.; Cohn, D. F.; Salama, R.; Streifler, M., and Weissman, S. L. (1980). **Skeletal findings in human neurolathyrism. Is there a human osteolathyrism?** European Neurology **19** (2):121-127
In a review of the roentgenological files of 22 patients suffering from spastic paraplegia due to neurolathyrism, 3 patients were found to present abnormal skeletal findings. 2 patients showed absence of union of the secondary ossification centres of the iliac crests, the ischial tuberosities and the vertebral bodies. Their age at the time of ingestion of poisonous Lathyrus sativus plants was 19 and 20 years. The 3rd patient had bowing and thickening of his right femoral shaft. He was 22 years old at the time of poisoning. These findings which are similar to those found in experimental osteolathyrism have never been described in clinical neurolathyrism. They are of a nature to throw some doubt on the correctness of the currently prevailing concept of sharp distinction between these two pathological entities.
Source: Medline 80224764; Reprinted with permission Copyright 1980 S Karger AG, Basel, Switzerland
Lathyrism complications/ Lathyrism radiography/ Lathyrism/ Neurology/ Lathyrus sativus/ Osteolathyrism/ Age/ Bones/ Lathyrism review Lathyrism skeletal/ Humans/ Neurolathyrism/ Paraplegia/ Review/ Skeletal/ Spasticity/ Spastic paraplegia/ Switzerland.

Ahmad, K. and Jahan, K. (1981). **Studies of neurolathyrism**. **First national seminar on lathyrism**, Dhaka.
Source: ref ex Haque and Mannan (1989)
Lathyrism Bangladesh/ Bangladesh lathyrism/ Neurology/ Bangladesh/ Lathyrism/ Neurolathyrism.

Anonymous (1981). First National Seminar on Lathyrism., in Dhaka University. Published in unpublished.
Lathyrism/ Lathyrus/ Bangladesh/ Food/ Lathyrism Bangladesh/ Lathyrism nutrition/ Nutrition.

Bhuiyan, A. Q. (1981). **Lathyrism in Bangladesh: A study of the victim families**. **First national seminar on lathyrism**, Dhaka.
Source: ref ex Haque and Mannan (1989)
Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrism socioeconomics/ Bangladesh/ Lathyrism.

Cohn, D. F. and Streifler, M. (1981). **Human neurolathyrism, a follow up study of 200 patients. Part I: Clinical investigation.** Schweiz Arch Neurol Neurochir Psychiatr **128** (1):151-156
Two hundred patients with chronic neurolathyrism were clinically examined, 25 to 35 years after exposure to the Lathyrus sativus pea. All the patients were prisoners in a labour camp under similar nutritional and physical conditions at the outbreak of the syndrome. The main symptoms were spastic paraparesis and a neurogenic bladder, both of varying degree. In addition lower motor neuron involvement with muscular atrophies was noticed in 14 cases and simulated amyotrophic lateral sclerosis. A lathyric sensory neuropathy was found in 12 patients. No cranial lesions or psychiatric disorders were found. Laboratory tests including 5 CSF specimens were normal. HLA typing was unremarkable. Our overall impression was that chronic neurolathyrism in the long run shows a gradually slow progressive course.
Source: Medline 81225713
Adult/ Aged/ Follow Up Studies/ Legumes/ Middle Age/ Muscle Spasticity diagnosis/ Nervous system diseases diagnosis/ Neuromuscular Diseases diagnosis/ Paralysis diagnosis/ Sensation/ Lathyrism diagnosis/ Neurology/ Lathyrus sativus/ Lathyrism symptoms/ Syndrome/ Age Amyotrophic lateral sclerosis/ cAMP/ Diagnosis/ HLA/ Lathyrism/ Lathyrism Aged/ Lathyrism motor neurons/ Humans/ Motor neurons Muscles/ Muscle spasticity/ Nervous system/ Neurolathyrism/ Neuromuscular/ Neurons/ Paralysis/ Physical/ Spasticity/ Spastic paraparesis Switzerland/ Symptoms lathyrism/ Nervous system diseases.

Cohn, D. F. and Streifler, M. (1981). **Human neurolathyrism, a follow up study. Part II: Special investigations.** Schweiz Arch Neurol Neurochir Psychiatr **128** (1):157-163
Special investigations were undertaken in the group of patients suffering from chronic neurolathyrism as described in part one of our work. X-ray films of the skeleton were taken of 45 patients. Pathologic findings similar to experimental osteolathyrism were revealed in 5 patients. These observations have not been described before. Sural nerve biopsies were taken from three patients with lathyric sensory neuropathy. Electron microscopy revealed mainly thick myelin sheaths which extended into the axonal regions. The picture is similar to the 'tomaculous' neuropathy of Bradley. The lower motor neuron was involved in a few cases, manifested by delayed nerve conduction time and muscular atrophies.
Source: Medline 81225714
Adolescence/ Adult/ Bone Diseases diagnosis/ Follow Up Studies/ Legumes/ Motor Neurons physiology/ Nervous system diseases diagnosis Neuromuscular Diseases diagnosis/ Sensation/ Lathyrism diagnosis/ Neurology/ Osteolathyrism/ Bones/ Diagnosis/ Lathyrism/ Lathyrism Adolescence/ Lathyrism motor neurons/ Humans/ Microscopy/ Motor neurons/ Muscles/ Myelin/ Nerves/ Nervous system/ Neurolathyrism Neuromuscular/ Neurons/ Physiology not plant/ Skeletal/ Switzerland/ Nervous system diseases.

Jenek, F.; Tekle Haimanot, R., and Hamory, B. H. (1981). **Nontraumatic adhesive archnoiditis as a cause of spinal cord syndromes**. Paraplegia **19**:140-154
Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ Neurology/ Lathyrism/ Paraplegia/ Spinal cord/ Syndrome.

Kaul, A. K. and Islam, M. Q. (1981). **Khesari (Lathyrus sativus) cultivation in Bangladesh and lathyrism**. Proc. First National Workshop on Pulses
Lathyrus sativus cultivation/ Lathyrism Bangladesh/ Lathyrus sativus/ Bangladesh/ Cultivation/ Grain legumes/ Pulses/ Grain legumes Bangladesh/ Khesari/ Lathyrism.

Lambein, F. and De Vos, B. (1981). **Lathyrism in young chicks induced by isoxazolin-5-ones from Lathyrus odoratus seedlings.** Archives Internationales De Physiologie, De Biochimie Et De Biophysique **88**:B66-67 (author affiliation: Laboratory of Physiological Chemistry, State University of Ghent, K.L. Ledeganckstraat 35, B-9000 Gent, Belgium)
NPAA toxicity/ Isoxazolin-5-one toxicity/ Bioassay poultry/ Poultry bioassay/ Seedling/ Lathyrus odoratus/ Bioassay/ Isoxazolin-5-one Agriculture/ Chemistry/ Belgium/ Lathyrism/ Lathyrism Bioassay/ Lathyrus toxicity/ NPAA/ NPAA chemistry/ Poultry/ Seedling chemistry Seedling NPAA/ Toxicity L. odoratus/ Toxicity.

Osmani, S. R. and Rahman, A. (1981). **A study on income distribution in Bangladesh**. Dhaka: Institute of Development Studies.

Source: ref ex Haque and Mannan (1989)
Lathyrism socioeconomics/ Socieconomics Bangladesh/ Economics/ Bangladesh/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism economics.

Pearson, S. and Nunn, P. B. (1981). **The neurolathyrogen, beta-N-oxalyl-L-alpha,beta-diaminopropionic acid, is a potent agonist at 'glutamate preferring' receptors in the frog spinal cord.** Brain Research **206** (1):178-82
A neurotoxic amino acid, beta-N-oxalyl-L-alpha,beta-diaminopropionate (beta-ODAP), found in seeds of Lathyrus sativus and a possible causative agent of neurolathyrism, was equipotent with kainate as a depolarizing agent of frog spinal cord ventral roots. beta-ODAP and kainate appeared to act on a common receptor, as their actions could not be differentiated pharmacologically. These results could explain some of the symptoms of neurolathyrism.
Source: Medline 81135095; Reprinted with permission Copyright 1981 Elsevier Science B.V., Amsterdam, Netherlands
Kainic Acid pharmacology/ Rana pipiens/ Rana temporaria/ Receptors Endogenous Substances drug effects/ Spinal Cord drug effects/ Amino acids Diamino pharmacology/ Receptors Endogenous Substances physiology/ Spinal Cord physiology/ ODAP/ Neurology/ Lathyrus sativus Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Lathyrism symptoms/ Amino acids/ Brain/ Drugs/ Endogenous/ Glutamates/ Kainic acid/ Lathyrism/ Lathyrism Bioassay/ Neurolathyrism/ Neurotoxins/ Physiology not plant/ Receptors/ Reptiles/ Roots/ Seed/ Spinal cord Symptoms lathyrism.

Schneider, G.; Oepen, H., and Klapproth, A. (1981). **The effect of the neurolathyrogenic substance beta, beta' iminodipropionitrile (IDPN) on some biological parameters in rats and mice.** Gen Pharmacol **12** (2):109-114
getreprint.
Source: Medline 81139582
Aging/ Body Weight drug effects/ Drinking drug effects/ Eating drug effects/ Growth drug effects/ Lathyrism chemically induced/ Mice/ Organ Weight drug effects/ Rats/ Reproduction drug effects/ Species Specificity/ Chorea chemically induced/ Nitriles pharmacology/ Rodents/ Body weight/ Chorea/ Drugs/ Lathyrism/ Lathyrism rats/ Nitriles/ Reproduction.

Streifler, M. and Cohn, D. F. (1981). **Chronic central nervous system toxicity of the chickling pea (Lathyrus sativus).** Clinical Toxicology **18** (12):1513-1517
Source: Agricola (79-84) IND 82049554
Lathyrism pathology/ Lathyrism central Nervous system pathology/ Neurolathyrism/ Forced labor camp/ Toxicity/ Neurology/ Lathyrus sativus cAMP/ Central Nervous system/ Lathyrism/ Lathyrus toxicity/ Nervous system/ Toxicity L. sativus.

Wattal, D. (1981). **Grass pea seed and lathyrism disease characterized by spastic paraplegia in human beings inhabiting geographical regions where the protein rich seeds form the staple food.** Botanica. Delhi, Delhi University Botanical Society **31**:104
Source: Agricola (79-84) IND 82114085
Lathyrus sativus India/ India L. sativus/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Delhi/ Food/ Geography/ India/ Lathyrism Humans/ Paraplegia/ Protein/ Seed/ Spasticity/ Spastic paraplegia.

Ahmad, K. and Jahan, K. (1982). **Neurolathyrism and L-ascorbic acid.** Food and Nutrition Bulletin **4** (4):missing in online article (author affiliation: Kamaluddin Ahmad and Khursheed Jahan; Institute of Nutrition and Food Science, University of Dacca, Dacca, Bangladesh)
Neurolathyrism is a disease that has crippled many thousands in the Indian subcontinent and elsewhere during the past several centuries (1). It struck poor people who used the seeds of Lathyrus sativus as the principal item in their diet continuously for a period of at least two to three months. The disease appeared to affect humans almost exclusively. No experimental animal model was available to facilitate biomedical research on the subject until recently, when we produced the condition in guinea pigs (2). When guinea pigs having a subacute deficiency of L-ascorbic acid were fed for four to five weeks on a diet of cooked L. sativus seeds supplemented with minerals and the usual vitamins except for L- ascorbic acid, they developed typical symptoms of neurolathyrism, affecting the hind limbs. The same condition also appeared within two to three hours following intraperitoneal administration of an extract of L. sativus (3) in guinea pigs previously made deficient in ascorbic acid by omitting it from a normal diet that did not include any L. sativus seeds. We further found that L-ascorbic acid not only protected the animals from the neurotoxic effect of L. sativus, but also had a curative effect on those that had earlier become paralysed by the toxicity of the seeds. We subsequently produced the same symptoms of neurolathyrism in monkeys made deficient in ascorbic acid by feeding them cooked L. sativus seeds or by administering extracts of L sativus intraperitoneally. Thus, a subacute deficiency of L-ascorbic acid that was not severe enough to produce scorbutic symptoms was found to be a precondition for the appearance of neurolathyrism attributed to L. sativus seeds. This also explained the failure to produce experimental neurolathyrism in laboratory animals that do not require any dietary supply of L-ascorbic acid or that were provided this vitamin in the experimental diet before we suspected that its

deficiency could be a predisposing factor. Finally, a neurotoxin, ß-N-oxalyl L -a, ß-diamino propionic acid (ODAP), isolated from L. sativus seeds (4), was administered intraperitoneally in two-day-old chicks. It produced neurological symptoms such as retraction of the head and paralysis of the legs, indicating damage to the central nervous system. REFERENCES: 1. S. L.N. Rao, K. Malathi, and P.S. Sarma, World Review of Nutrition and Dietetics, 10: 214 (Karger, Basel, New York, 19691; 2. K. Ahmad and K. Jahan, The Third Asian Congress of Nutrition, Jakarta, Indonesia, 6-10 Oct. 1980, p. 190; 3. V, Nagarajan and C. Gopalan, "Production of Neurolathyrism in Chicks by Injection of Lathyrus sativus Concentrates," Current Sci, 32: 116(1963h); 4. S.L.N Rao, P.R. Adiga, and P.S. Sarma, "Isolation and Characterisation of ß-N-oxalyl L a, ß-diamino Propionic Acid, a Neurotoxin from Seeds of Lathyrus sativus," Biochem., 3: 432 (1964).
Neurolathyrism/ Neurolathyrism Vit C/ Vitamin C/ Vitamin C lathyrism/ Vitamin C neurolathyrism/ Lathyrism.

Ahmad, K.; Jahan, K., and Islam, Z. (1982). **Neurolathyrism and MSG**. Nutrition News **1** (11):1-4
Lathyrism Mono-sodium glutamate/ Glutamates/ Neurology/ Lathyrism/ Lathyrism nutrition/ Neurolathyrism/ Nutrition/ Sodium.

Ahmed, K. A. (1982). **Lathyrism: Some issues for consideration**. Second National Seminar on Lathyrism, organised by Shaw Unnayan, Rajshahi.
Source: ref ex Kaul et al. (1989)
Lathyrism.

Ahmed, M. and Khanam, M. (1982). **Some psychological aspects of the prevention of lathyrism**. Second National Seminar on Lathyrism, organised by Shaw Unnayan, Rajshahi.
Source: ref ex Kaul et al. (1989)
Lathyrism psychology/ Lathyrism prevention/ Prevention lathyrism/ Psychology/ Socioeconomics/ Economics/ Lathyrism/ Lathyrism economics.

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Source: reprintDE
NPAA/ Screening/ Agronomy/ Bangladesh/ ODAP/ Lathyrus sativus/ Agriculture/ Genetic resources/ Cultivars/ Environmental variation ODAP/ Environment/ Khesari/ Lathyrism Bangladesh/ Lathyrus sativus agronomy/ Neurotoxins/ Protein/ Protein content/ Toxin/ reprint.

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Two hundred patients with chronic neurolathyrism were examined 25-35 years after the appearance of signs and symptoms of intoxication of the chickling pea. Their daily food intake, in a German forced labor camp during World War II, consisted of 400 g Lathyrus sativus peas cooked in water plus 200 g bread baked of barley and straw. Apart from the classic signs of neurolathyrism, i.e., a spastic paraparesis, in five cases, the skeletal findings observed were similar to experimental osteolathyrism. There was an absence of ossification centers of the iliac creasts, ischial tuberosities and vertebrae; and bowing with thickening of the femoral shaft also occurred. These bony changes in human lathyrism have not been described before.
Source: Medline 84023104; Reprinted with permission Copyright 1983 Springer Verlag
Adolescence/ Adult/ Bone Diseases radiography/ Follow Up Studies/ Middle Age/ Osteogenesis/ Bone Diseases etiology/ Lathyrism physiopathology/ Nervous system diseases etiology/ Neurology/ Lathyrus sativus/ Osteolathyrism/ Straw/ Agriculture/ Lathyrism symptoms Age/ Hordeum/ Bones/ Bread/ cAMP/ Food/ Forced labor camp/ Germany/ Intake/ Lathyrism/ Lathyrism Adolescence/ Lathyrism etiology Lathyrism radiography/ Lathyrism skeletal/ Lathyrus toxicity/ Humans/ Nervous system/ Neurolathyrism/ Skeletal/ Spasticity/ Spastic paraparesis/ Symptoms lathyrism/ Toxicity Osteolathyrism/ Toxicity L. sativus/ Toxicity/ Water/ Nervous system diseases.

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Among the many biologically active and potentially toxic factors known to be present in plant foodstuffs normally consumed by man, those that are present in legumes have received the most attention. Two categories of legume toxins will be considered - those whose effects have been extensively studied in experimental animals but whose significance in man must remain open to conjecture, and those which are known to produce toxic effects in man but whose identity remains uncertain because similar effects are not readily reproduced in animal models. The protease inhibitors have, over the years, been the object of much study in experimental animals where they have been observed to have an adverse effect on growth and to cause pancreatic enlargement. The relevance of these observations to human nutrition remains obscure, however, because of our lack of knowledge concerning the effect of soybean trypsin inhibitors on the human pancreas. Lectins from certain legumes such as the common bean (Phaseolus vulgaris) have been shown to be toxic to animals upon oral ingestion presumably because of the damage which they inflict upon binding to the cells lining the intestinal mucosa. Lectins may therefore be responsible for reported cases of human intoxication associated with the consumption of inadequately cooked beans. Lathyrism and favism are diseases in man which are associated with the consumption of Lathyrus sativus and Vicia faba respectively. Evidence leading to the probable identification of the causative factors of these diseases and the steps necessary for their elimination will be discussed.
Source: Medline 84023099; Reprinted with permission Copyright 1983 Springer Verlag
Favism etiology/ Lathyrism etiology/ Lectin toxicity/ Protease Inhibitors toxicity/ Diet/ Food Contamination/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Lathyrus sativus/ Contamination/ Favism/ Food/ Glycine max/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism nutrition/ Lathyrus toxicity/ Lectin/ Humans/ Models/ Nutrition plant/ Nutrition animal/ Nutrition/ Phaseolus vulgaris Toxicity L. sativus/ Toxicity/ Toxin/ Vicia/ Vicia faba.

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Lathyrism, one of the oldest neurotoxic diseases known to Man, results from excessive consumption of the chickling pea, Lathyrus sativus, and certain related species. Once prevalent throughout Europe, N. Africa, Middle East and parts of the Far East, the disease is presently restricted to India, Bangladesh and Ethiopia. Lathyrism is a form of irreversible, non-progressive spastic paraparesis associated with poorly understood degenerative changes in spinal cord. Domestic animals, notably the horse, also develop hindlimb paralysis after prolonged feeding on Lathyrus fodder. Experimental animal models of lathyrism have been reported but none has been satisfactorily investigated, and concurrence between these experimental diseases and the human condition is unproven. The culpable agent in Lathyrus species that precipitates paralysis also is unknown. Current attention is focused on the glutamate analog, beta-(N)-oxalyl-amino-L-alanine acid (BOAA). While this compound is present in those Lathyrus species that induce spastic paraparesis and, in large doses, reportedly causes neuropathological changes similar to glutamate neurotoxicity, there is little to compare these neuropathological changes with those found in human lathyrism. Chronic primate feeding studies utilizing BOAA need to be carried out to determine whether this agent is responsible for human lathyrism. Some species of Lathyrus, notably Lathyrus odoratus, are unable to induce human lathyrism but contain a compound, beta-aminopropionitrile (BAPN), that induces pathological changes in bone ('osteolathyrism') and blood vessels ('angiolathyrism') of experimental animals without damaging the nervous system. However, related compounds, dimethylaminopropionitrile (DMAPN) and beta, beta'-iminodipropionitrile (IDPN), are chronic neurotoxins in humans and animals, respectively.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: Medline 84142544
Beta Alanine isolation and purification/ Beta Alanine toxicity/ Disease Models Animal/ Lathyrism diagnosis/ Lathyrism veterinary/ Plants Toxic analysis/ Saimiri/ Lathyrism etiology/ Neurotoxins isolation and purification/ ODAP/ Neurology/ Forage/ Lathyrus sativus/ Lathyrus odoratus

Osteolathyrism/ Horses/ Agriculture/ Beta Alanine analogs and derivatives/ Africa/ Aminopropionitriles/ Bangladesh/ Blood/ Bones/ Diagnosis Ethiopia/ Europe/ Experimental lathyrism/ Feeding/ Fodder/ Glutamates/ Hindlimbs/ Horse diseases/ Horses lathyrism/ India/ India L. sativus India L. sativus consumption/ India lathyrism/ Isolation/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bangladesh Lathyrism Ethiopia/ Lathyrism experimental/ Lathyrism France/ Lathyrism horses/ Lathyrism India/ Lathyrus toxicity/ Primates/ Humans Middle East/ Models/ Nervous system/ Neurotoxicity/ Neurotoxins/ Paralysis/ Prevalence/ Purification/ Spasticity/ Spastic paraparesis/ Spinal cord/ Toxicity ODAP/ Toxicity Osteolathyrism/ BAPN/ Toxicity beta aminopropionitrile/ Toxicity L. odoratus/ Toxicity L. sativus/ Toxicity.

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Experimental cyanide exposure in animals causes demyelination and circumstantial clinical and laboratory evidence suggest that there are human parallels. In Leber's hereditary optic atrophy there appears to be a defect in the conversion of cyanide to thiocyanate because of deficient rhodanese activity. For transmitters of the disease smoking carries the risk of blindness and in the most severely affected patients, there is diffuse neurological disease. It is possible that other hereditary optic atrophies (dominant and recessive) may also reflect inborn errors of cyanide metabolism. In the retrobulbar neuritis and optic atrophy of vitamin B12 deficiency there may be a conditional abnormality of cyanide metabolism in smokers, and likewise in so-called tobacco-alcohol amblyopia in which there are more complex nutritional deficiencies. Epidemiological evidence (differing sex ratios, excess of smokers) indicates that defective cyanide metabolism may contribute to the development of sub-acute combined degeneration of the cord in vitamin B12 deficiency. In protein-malnourished populations consuming large amounts of cyanide or cyanogens, viz. in tropical Africa where the staple diet includes cassava containing large amounts of linamarin, similar maladies occur as acquired disorders. There may be a similar explanation for lathyrism. The known pathways of human cyanide metabolism are reviewed and evidence supporting the clinical data is presented.
Source: Medline 84058805; Reprinted with permission Copyright 1983 Academic Press
Lathyrism similarity to Cyanide toxicity/ Africa/ Cyanides/ Deficiency/ Demyelination/ Diet/ HCN/ Lathyrism/ Lathyrism animals/ Lathyrism review/ Humans/ Manihot esculenta/ Cassava/ Metabolism/ Myelin/ Optic/ Population/ Protein/ Review/ Risk/ Sex/ Thiocyanates/ Nicotiana Toxicity/ Tropics/ Vitamins.

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Source: FSTA 17(12) 1985
Lathyrus/ Lathyrism physiopathology/ Lathyrism animal models/ Lathyrism bioassay rats/ Lathyrism pathology/ Kidneys/ Bioassay L. sativus Bioassay rodent/ Bioassays/ Biochemistry.

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Experiments with Chicks

These studies demonstrate the toxicity of MSG in one-day-old chicks weighing 32-35 9. Different amounts of MSG were put into 0.5 ml of water and administered intraperitoneally. The results are presented in table 1. While a dose of 2 g/kg body weight caused only mild symptoms, toxicity became severe when the dose was raised to 2.5 g/ kg.

The preventive action of AA against the toxicity of MSG at a dose of 2.5 g/kg in these chicks is presented in table 2, part A, which shows that 0.75 mg of AA given intraperitoneally 10 minutes before the administration of MSG protected all the birds.

Experiments with Guinea-pigs and Monkeys

These studies were made to demonstrate the curative action of AA against MSG toxicity in adult guinea-pigs and monkeys, which are not able to biosynthesize AA. Guinea-pigs weighing 300-350 9 and monkeys weighing 2.5-3 kg were selected. They were made deficient in AA by feeding an AA-deficient diet until serum AA levels fell to 0.3-0.4 mg/dl. At this point no scorbutic symptoms were seen. A dose of 2 g/kg of MSG was administered to each animal intraperitoneally in a 0.5-ml aqueous solution. Results are shown in table 2, parts B and C. All the animals became sick, but 5 mg of AA given subcutaneously cured all of the guinea-pigs, and 50 mg cured all monkeys. These doses were arbitrary.

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Studies on the preventive and curative action of ascorbic acid on the neurological toxicity of monosodium glutamate

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INTRODUCTION

Olney and Ho and others have described the toxic effect of subcutaneous administration of large doses of monosodium glutamate (MSG) in young mice (1, 2). Degenerative changes in the retina of the infant mouse after subcutaneous treatment with MSG was reported earlier by Lucas and Newhouse (3). Potts et al. also showed that MSG caused irreversible retinal pathology (4, 5). The use of MSG in infant formula diets has raised concern lest it cause any health hazard. It was suggested that MSG could also be responsible for the Chinese-restaurant syndrome (6, 7). Studies have also exonerated MSG from this incrimination (8).

In the course of their studies on neurolathyrism caused by Lathyrus sativus (LS), various neurological manifestations were reported by V. Nagarajan and C. Gopalan in one-day- old chicks when the latter were given extracts of LS seeds intraperitoneally (9). Subsequently a neuroactive amine, b-N-oxalyl-L-a, b-diaminopropionic acid (ODAP), was isolated from the seeds of LS that mimicked the neurological symptoms caused by the extract (1012). We found that such symptoms did not appear in the chicks when they were given ascorbic acid (AA) some 10 to 15 minutes before the administration of the toxic extract of LS. It was further found that adult guinea-pigs and monkeys, which need a dietary source of AA, developed paralysis of the hind legs and sometimes respiratory difficulty if an extract of LS was administered to them after they had been fed an AA-deficient diet for some weeks to lower their serum AA level to 0.2-0.4 mg/dl. At this stage of deficiency there were no scorbutic symptoms (such as subcutaneous haemorrhage). The conditions paralleled to a great extent those seen in human neurolathyrism, but no such symptoms were seen in those animals that were not made deficient in AA prior to the administration of the toxic extract. These symptoms were found to be reversible if AA was given immediately after the appearance of symptoms. It was concluded that AA counteracted the neurotoxicity of ODAP from LS (13,14). We now provide additional data.

Glutamate has been recognized to be both neuroexcitory and neurotoxic. Biological actions of ODAP and glutamate (MSG) have been correlated (15). It occurred to us that the toxic effect of MSG reported in young animals could possibly be counteracted by AA. As described below, it has been our finding that AA does protect young animals from the neurological symptoms that arise from administration of a high dose of MSG. AA can both prevent and cure the toxic effects of MSG. Therefore, the incorporation of AA with MSG in food preparations might possibly preclude toxic reactions to MSG in human subjects.

TABLE 1. Toxicity of Monosodium Glutamate in One-Day-Old Chicks Weighing 32 to 35 Grams

Amount of MSG	Number of Animals	Observations and Remarks
MSG1.5 g/kg of body weight	30	No apparent abnormality noted.
2 g/kg of body weight	30	All animals showed drowsiness after 20-30 minutes.
2.5 g/kg of body weight	30	All developed neck drooping; 18 developed paralysis of legs, neck rigidity, and convulsions after 45-90 minutes. 25 recovered and 5 were found dead the following morning.
3 g/kg of body weight	30	27 developed neck rigidity, extensor paralysis of legs, and convulsions; hyperextension of knee and ankle joints; the remaining 3 showed tremor and failed to walk. 15 died in the following 12 hours; all but 2 died within 48 hours.

MSG was administered in a 0.51-ml aqueous solution intraperitoneally.

TABLE 2. Preventive and Curative Action of Ascorbic Acid (AA) in Glutamate (MSG) Toxicity

	Number of Animals	Amount of MSG g/ kg Body Wt.	Amount of AA, mg per Animal	Observations and Remarks
A. One-day-old chicks, 32-35 g	50	2.5	0.75a	These are minimum amounts of AA needed for prevention of neurological symptoms in all animals. AA was given 10 minutes before MSG.
B. AA-deficient guinea-pigs (300-350 g); serum AA 0.3-0.5 mg/dl	20	2.0	5b	8 animals developed drowsiness and neck droop; the rest developed weakness and paralysis of hind legs, tremor, convulsions, etc. 45-60 minutes after intraperitoneal injection of MSG. Animals were cured by administration of AA subcutaneously soon after appearance of symptoms.c
C. AA-deficient monkeys (2.5-3 kg); serum AA 0.3-0.5 mg/dl	6	2.0	50b	All animals developed paralysis of hind legs 11/2-3 hours after intraperitoneal administration of MSG; 4 developed respiratory distress. All animals were cured by administration of AA intramuscularly immediately after appearance of symptoms.c

a. Minimum preventive dose per chick
b. Administered after the symptoms appeared (arbitrary curative dose)
c. The animals were later put on a diet supplemented with ascorbic acid-guinea-pigs 5 mg/day; monkeys 50 mg/day.

EXPERIMENTS AND RESULTS

Experiments with Chicks

These studies demonstrate the toxicity of MSG in one-day-old chicks weighing 32-35 9. Different amounts of MSG were put into 0.5 ml of water and administered intraperitoneally. The results are presented in table 1. While a dose of 2 g/kg body weight caused only mild symptoms, toxicity became severe when the dose was raised to 2.5 g/ kg.

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Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ Neurology/ Lathyrism/ Tropics.

Ross, S. M.; Roy, D. N., and Spencer, P. S. (1985). **Beta-N-Oxalylamino-L-alanine: action on high affinity transport of neurotransmitters in rat brain and spinal cord synaptosomes.** Journal of Neurochemistry **44** (3):886-892
beta-N-Oxalylamino-L-alanine (BOAA) is a dicarboxylic diamino acid present in Lathyrus sativus (chickling pea). Excessive oral intake of this legume in remote areas of the world causes humans and animals to develop a type of spastic paraparesis known as lathyrism. BOAA is one of several neuroactive glutamate analogs reported to stimulate excitatory receptors and, in high concentrations, cause neuronal vacuolation and necrosis. The present study investigates the action of BOAA in vitro on CNS high-affinity transport systems for glutamate, gamma-aminobutyric acid (GABA), aspartate, glycine, and choline and in the activity of glutamate decarboxylase (GAD), the rate-limiting enzyme in the decarboxylation of glutamate to GABA. Crude synaptosomal fractions (P2) from rat brain and spinal cord were used for all studies. [3H]Aspartate transport in brain and spinal cord synaptosomes was reduced as a function of BOAA concentration, with reductions to 40 and 30% of control values, respectively, after 15-min preincubation with 1 mM BOAA. Under similar conditions, transport of [3H]glutamate was reduced to 74% (brain) and 60% (spinal cord) of control values. High-affinity transport of [3H]GABA, [3H]glycine, and [3H]choline, and the enzyme activity of GAD, were unaffected by 1 mM BOAA. While these data are consistent with the excitotoxic (convulsant) activity of BOAA, their relationship to the pathogenesis of lathyrism is unknown.
Source: Medline 85133654; Reprinted with permission Copyright 1989 Raven Press
Beta Alanine pharmacology/ Aspartic Acid metabolism/ Biological Transport Active drug effects/ Brain drug effects/ Choline metabolism Glutamates metabolism/ GABA metabolism/ Rats/ Rats Inbred Strains/ Spinal Cord drug effects/ Synaptosomes drug effects/ Alanine analogs and derivatives/ Brain metabolism/ Neuroregulators metabolism/ Spinal Cord metabolism/ Synaptosomes metabolism/ Rodents/ ODAP Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Synaptosomes/ Aminobutyric Acids/ Aspartic acid/ Brain/ Central Nervous system/ Drugs/ Enzymes/ GABA/ Glutamates/ Glycine/ In vitro/ Intake/ Lathyrism/ Lathyrism animals/ Lathyrism rats/ Humans/ Metabolism Nervous system/ Receptors/ Spasticity/ Spastic paraparesis/ Spinal cord/ Strains/ Synapses.

Singh Deo, R. C. (1985). **Khesari dal cultivation in M. P. - Problems and remedial measures**. Bhopal, India: State Planning Board, Government of M. P.
Lathyrism India/ Lathyrism socioeconomics/ Lathyrus sativus socieconomics/ Socieconomics L. sativus/ Economics/ Lathyrus sativus Cultivation/ Dhal/ India/ India L. sativus/ India lathyrism/ Khesari/ Lathyrism/ Lathyrism economics.

Ahmad, K. and Hasan, N. (1986). **Nutrition survey of rural Bangladesh 1981-82**. Dhaka: Institute of Nutrition and Food Science, Dhaka University. Standard printing and packages.
Source: ref ex Haque and Mannan (1989)

Bangladesh nutrition/ Lathyrism nutrition/ Lathyrism socioeconomics/ Economics/ Bangladesh/ Food/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism economics/ Nutrition/ Nutrition surveys/ Rural/ Surveys.

Bashar, M. A.; Fabres, G., and Labeyrie, V. (1986). **Stimulation of ovogenesis by flowers of Lathyrus sylvestris L and Lathyrus latifolius L in Bruchus affinis Fr'hlich (Col Bruchidae)**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 202-212.
Source: reprintDE
Lathyrus sylvestris/ Lathyrus latifolius/ Bruchus affinis/ Lathyrus sylvestris B. affinis/ Lathyrus latifolius B. affinis/ Entomology/ Bruchids Bioassay/ Agriculture/ Bruchus/ Coleoptera/ Flowers/ France/ Lathyrism Bioassay/ Lathyrus sylvestris/ reprint.

Bharati, M. P. (1986). **Status of Lathyrus sativus among grain legumes cultivated in Nepal**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 142-145.
Source: reprintDE
Lathyrus sativus Nepal/ Lathyrism/ Nepal L sativus cultivation/ Lathyrus sativus/ Cultivation/ France/ Grain legumes/ Pulses/ Nepal/ reprint.

Butler, E. A. (1986). **Studies in the seedcoat of Lathyrus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 25-28.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ reprint.

Calne, D. B.; Eisen, A.; McGeer, E., and Spencer, P. S. (1986). **Alzheimer's disease, Parkinson's disease, and motoneurone disease: abiotrophic interaction between ageing and environment?** The Lancet **2** (8515):1067-1070
The hypothesis is that Alzheimer's disease, Parkinson's disease (PD), and motoneurone disease are due to environmental damage to specific regions of the central nervous system and that the damage remains subclinical for several decades but makes those affected especially prone to the consequences of age-related neuronal attrition. This proposal is based on the association between environmental factors and certain neurodegenerative diseases (eg, methylphenyltetra-hydropyridine and parkinsonism, poliovirus infection and post-poliomyelitis syndrome, chickling pea ingestion and lathyrism, an unidentified environmental factor and amyotrophic lateral sclerosis-PD complex of Guam, and trauma and pugilist's encephalopathy) and on the long latent period between exposure to environmental factor and the appearance of symptoms in some of these disorders. The practical implications of this hypothesis are that epidemiological attention should be focussed on the environment in early rather than late life, prevention may be a realistic goal if the cause of subclinical damage can be identified, a search should be undertaken for causal mechanisms linking subclinical neuronal damage due to an environmental factor and the normal ageing process, and (4) better understanding of the regional selective vulnerability of the nervous system to the ageing process might allow a rational approach to treatment.
Source: Medline 87038379
Adult/ Alzheimer's Disease pathology/ Environmental Exposure/ Guam/ Lathyrism pathology/ Lathyrism physiopathology/ Neuromuscular Diseases pathology/ Neurons pathology/ Neurons physiopathology/ Parkinson Disease pathology/ Poliomyelitis pathology/ Poliomyelitis physiopathology/ Pyridines adverse effects/ Time Factors/ Aging/ Alzheimer's Disease etiology/ Motor Neurons/ Neuromuscular Diseases etiology/ Parkinson Disease etiology/ Lathyrism symptoms/ Syndrome/ Age/ Amyotrophic lateral sclerosis/ Central Nervous system Environment/ Infection/ Lathyrism/ Lathyrism etiology/ Lathyrism mechanisms/ Lathyrism prevention/ Mechanism/ Motor neurons/ Nervous system/ Neurodegenerative/ Neurology/ Neuromuscular/ Neurons/ Prevention lathyrism/ Lathyrism prevention/ Pyridines/ Symptoms lathyrism.

Chaib, A.; Delbos, M., and Combes, D. (1986). **Preliminary studies on the genetic variability of three perennial species of Lathyrus (L tuberosus L, L sylvestris L and L latifolius L): chromosomal and reproductive aspects**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 98-104.
Source: reprintDE
Lathyrus/ Lathyrus sylvestris/ Lathyrus sativus/ France/ Lathyrus sylvestris/ Perennials/ Reproduction/ reprint.

Cohn, D. F. (1986). **Does human osteolathyrism exist?** In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 315-317.
Source: reprintDE
Lathyrus sativus toxicity/ Osteolathyrism L. sativus/ Lathyrus sativus/ Osteolathyrism/ France/ Lathyrism/ Lathyrus toxicity/ Humans/ Toxicity Osteolathyrism/ Toxicity L. sativus/ Toxicity/ reprint.

Dahiya, B. S. (1986). **Genetics and stability analysis in grasspea (L sativus L)'. Its implications in future breeding programmes**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 161-168.
Source: reprintDE
Genetics/ Lathyrus sativus genetics/ Genetics L sativus/ Lathyrus sativus low ODAP/ Lathyrus sativus/ Breeding/ France/ Genetics ODAP ODAP/ reprint.

Delgado-Montero, V. M. and Moreno, R. (1986). **Callus induction and culture from different explants of Lathyrus sativus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 169-170.
Source: reprintDE
Tissue culture L. sativus/ Lathyrus sativus/ Callus/ France/ Tissue culture/ reprint.

Dwivedi, S. C.; Sharma, M. C., and Pathak, N. N. (1986). **Indigenous plant poisoning in farm animals: mode of therapy.** Indian Journal of Indigenous Medicines **5**:14-18
Source: Copyright CAB Abstracts (87-89) V821460
Toxic substances/ Lathyrism/ Antidotes/ Poultry diseases/ Cattle diseases/ Horse diseases/ Poisonous plants/ Ruminants/ Lathyrus sativus/ Cattle Horses/ Agriculture/ Horses lathyrism/ India/ India L. sativus/ India lathyrism/ Lathyrism animals/ Lathyrism horses/ Lathyrism India Lathyrism therapy/ Lathyrus toxicity/ Plant poisoning/ Poultry/ Ruminants L. sativus/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity.

Essad, S. (1986). **Identification of chromosomes of Lathyrus tuberosus L**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 55-59.
Source: reprintDE
Lathyrus tuberosus chromosomes/ Chromosomes L. tuberosus/ Cytology/ Cytogenetics/ Chromosomes/ France/ Lathyrus tuberosus/ reprint.

Goyder, D. J. (1986). **The genus Lathyrus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 3-7.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ reprint.

Hamid, M. A.; Kaul, A. K., and Akanda, R. U. (1986). **Lathyrism in Bangladesh. An agronomic survey of two lathyrism prone areas**. Dhaka??: Department of Economics Rajshahi University, Rajshahi and Ford Foundation, Dhaka.
Lathyrus sativus Bangladesh/ Socioeconomics Bangladesh/ Bangladesh socioeconomics/ Survey socioeconomic/ Lathyrism Bangladesh Bangladesh lathyrism/ Economics/ Lathyrus sativus/ Bangladesh/ Lathyrism/ Lathyrism economics/ Surveys.

Hossaert, M.; Bashar, A., and McKey, D. (1986). **Floral nectar production in relation to insect activity in Lathyrus latifolius L**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 213-221.
Source: reprintDE
Lathyrus latifolius/ Nectar production L. latifolius/ Lathyrus latifolius nectar production/ Entomology/ Agriculture/ Floral/ France/ Honey Insects/ Nectar/ reprint.

Hossaert, M. and Valero, M. (1986). **Vegetative propagation and sexual reproduction in two perennial Lathyrus species**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 175-183.
Source: reprintDE
Lathyrus sylvestris/ Lathyrus latifolius/ Perennials/ Vegetative propagation L. sylvestris/ Vegetative propagation L. latifolius/ France/ Lathyrus sylvestris/ Reproduction/ Sexual/ reprint.

Islam, M. S.; Saha, C. S.; Shaikh, M. A. Q., and Lahiri, B. P. (1986). **Spectrum of variability in seed size and content of protein and BOAA in grasspea (Lathyrus sativus L.) germplasm**. Bangladesh Journal of Nuclear Agriculture **2**:6-9.
Seeds of grasspea contain an unusual amino acid, B-(N)-Oxalyl-amino-L-alanine (BOAA) which is responsible for an incurable paralysis of the lower limbs of men, called lathyrism. This study included sixteen local and seven exotic cultivars of grasspea to ascertain the variability and the relationship existing among seed size and content of protein and BOAA in the seeds. Weight of 1000 seeds varied from 40-67 gm and the

exotic germplasm had comparatively bigger seeds than the local cultivars. The protein and BOAA percent ranged from 24.54 to 34.05 and 0.22 to 2.08, respectively. A significant positive correlation was obtained only between seed size and protein content (0.775) but negative association was obtained between seed size and BOAA. There was no association between the content of protein and BOAA. Therefore, it may be feasible to develop low neurotoxin varieties by selecting for bold seed size following hybridization of bold seeded and low neurotoxin types with those having small seeds and high neurotoxin.
Source: CODIS 88-100600
Lathyrus sativus ODAP/ Lathyrus sativus protein/ Genetic resources L. sativus Bangladesh/ Seed size L. sativus Bangladesh/ Bangladesh L. sativus genetic resources/ Genetic variation L. sativus Bangladesh/ Lathyrus sativus/ Agriculture/ Genetic resources/ Amino acids/ Bangladesh Cultivars/ Genetic variation/ Lathyrism/ Lathyrism Bangladesh/ Humans/ Neurotoxins/ ODAP/ Paralysis/ Protein/ Protein content/ Seed/ Seed size/ Varieties/ Genetic resources L. sativus.

Kaul, A. K. and Combes, D. (Eds) (1986). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**. New York: Third World Medical Research Foundation.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ reprint.

Kaul, A. K.; Islam, M. Q., and Hamid, A. (1986). **Screening of Lathyrus germplasm of Bangladesh for BOAA content and some agronomic characteristics**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 130-131.
Source: reprintDE
Lathyrus sativus ODAP/ Lathyrus sativus Bangladesh/ Bangladesh L. sativus/ ODAP genetic variation/ Agronomy/ Lathyrus sativus Agriculture/ Genetic resources/ Bangladesh/ France/ Genetic variation/ Lathyrism Bangladesh/ Lathyrus sativus agronomy/ ODAP/ Screening reprint.

Kislev, M. E. (1986). **Archaeobotanical findings on the origin of Lathyrus sativus and L. cicera**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 46-51.
Source: reprintDE
Lathyrus/ Archaeobotany/ History/ Lathyrus sativus/ Lathyrus cicera/ France/ Lathyrism history/ Lathyrism L. cicera/ reprint.

Kuo, Y.-H.; Ongena, G., and Lambein, F. (1986). **Transport of isoxazolinone derivatives in Lathyrus odoratus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 257-264.
Source: reprintDE
Isoxazolin-5-one transport L. odoratus/ Lathyrus odoratus/ Isoxazolin-5-one/ France/ reprint.

Labeyrie, V. (1986). **Plant - Insect relationships**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation.
Source: reprintDE
Plant Insect Co-evolution/ Entomology/ Agriculture/ Evolution/ France/ Insects/ reprint.

Lal, M. S.; Agrawal, I., and Chitale, M. W. (1986). **Genetic improvement of chickling vetch (Lathyrus sativus L.) in Madhya Pradesh, India**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 146-160.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ India/ India L. sativus/ India Madhya Pradesh/ India lathyrism/ Lathyrism/ Lathyrism India/ Madhya Pradesh/ reprint.

Lambein, F.; De Bruyn, A.; Ikegami, F., and Kuo, Y.-H. (1986). **Distribution and biosynthesis of isoxazolinone derivatives in the genus Lathyrus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 246-256.
Source: reprintDE
NPAA Lathyrus/ NPAA/ Biosynthesis/ Isoxazolin-5-one/ France/ Lathyrism/ NPAA biosynthesis/ reprint.

Lavania, U. C. and Sharma, A. K. (1986). **Interphase chromosome arrangement and the mode of heterochromatin evolution as revealed in Lathyrus**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and**

Lathyrism. Proceedings of the International Symposium 9-13 September France, New York: Third World Medical Research Foundation, pp. 60-66.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ Chromosomes/ Evolution/ France/ Heterochromatin/ reprint.

MacDonald, J. F.; Morris, M. E., and Mijkovic, Z. (1986). **Mechanism of excitation of central mammalian neurones by L-3-oxalylamino-2-amino-propionic acid (isolated from Lathyrus sativus)**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 306-314.
Source: reprintDE
Lathyrus sativus toxicity/ ODAP mechanism of action/ Lathyrus sativus/ France/ Lathyrism/ Lathyrism mechanisms/ Lathyrus toxicity Mechanisms toxicity/ ODAP/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity mechanism ODAP/ Toxicity reprint.

Marinval, P. (1986). **Decouvertes et utilisations des graines de Lathyrus sativus et L. cicera en France du mesolithique (9000 B. P.) Jusqu'au moyen-age (1300 A. D.)**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, N. Y.: Third World Medical Research Foundation, pp. 39-45.
Source: reprintDE
Lathyrus/ History/ Archaeobotany/ France/ Lathyrus sativus/ Lathyrus cicera/ Age/ Lathyrism France/ Lathyrism history/ Lathyrism L. cicera reprint.

Murti, V. V. S. (1986). **Neurotoxic activity of some oxalyl-amino acids**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 318-320.
Source: reprintDE
Lathyrus toxicity/ Oxalyl-amino acids neurotoxicity/ NPAA/ NPAA L. sativus/ Neurology/ Lathyrus sativus/ Amino acids/ France/ Lathyrism Neurotoxicity/ Neurotoxins/ Toxicity L. sativus/ Toxicity/ reprint.

Narayan, R. K. J. (1986). **DNA changes in chromosome differentiation and evolution in Lathyrus**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 67-79.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ Chromosomes/ Differentiation/ DNA/ Evolution/ France/ reprint.

Plitmann, U.; Heyn, C. C., and Weinberger, H. (1986). **Comparative taxonomy of some wild species allied to Lathyrus sativus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 8-21.
Source: reprintDE
Lathyrus sativus related spp/ Taxonomy Lathyrus spp/ Taxonomy L. sativus et al./ Lathyrus gorgoni/ Lathyrus pseudocicera/ Lathyrus sativus Taxonomy/ France/ Lathyrus spp/ Taxonomy L. sativus/ Wild species/ Wild/ reprint.

Quader, M.; Ramanujam, S., and Barat, G. K. (1986). **Genetics of flower colour, BOAA content and their relationship in Lathyrus sativus L**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 93-97.
Source: reprintDE
Lathyrus/ ODAP/ Lathyrus sativus/ Colour/ Flower colour/ Flower colour genetics/ Flowers/ France/ Genetics/ Genetics flower colour/ Genetics ODAP/ reprint.

Rees, H. (1986). **The consequences of DNA change in chromosomes**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 86-89.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ Chromosomes/ DNA/ France/ reprint.

Rouge, P.; Garcia, M.-L.; Boisseau, C., and Causse, H. (1986). **Immunochemical crossreactions between Lathyrus lectins and isolectins measured by an enzyme linked immunosorbent assay (ELISA) technique: phylogenetical and taxonomical implications**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 265-272.
Source: reprintDE

ELISA/ Enzymes/ France/ Isolectins/ Lathyrus spp/ Lectin/ reprint.

Rouge, P.; Ranfaing, P.; Pere, D.; Richardson, M.; Yarwood, A., and Sousa-Cavada, B. (1986). **Amino acid sequence and structure of Lathyrus lectins as a tool for the molecular aspects of Lathyrus speciation**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 273-284.
Source: reprintDE
Amino acids/ Amino acid sequence/ France/ Lectin/ Molecular/ Speciation/ Lathyrus spp/ reprint.

Roy, D. N.; Spencer, P. S., and Nunn, P. B. (1986). **Toxic components of Lathyrus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 287-296.
Source: reprintDE
Lathyrus toxicity review/ France/ Lathyrism review/ Lathyrus toxicity/ Review/ Toxicity/ reprint.

Sharma, A. K.; Chowdhury, R. K., and Mukherjee, S. (1986). **DNA content and repetitive DNA in Lathyrus sativus at intraspecific level**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 80-85.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ DNA/ DNA content/ France/ Intraspecific/ Repetitive DNA/ reprint.

Simola, L. K. (1986). **Structural and chemical aspects of evolution of Lathyrus species**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 225-239.
Source: reprintDE
Leaf anatomy/ NPAA/ NPAA tissue distribution/ NPAA plant development/ Lathyrus seed protein serology/ Seed protein serology/ Lathyrus niger/ Lathyrus maritimus/ Lathyrus sylvestris/ Lathyrus japonicus/ Anatomy plant/ Chemotaxonomy/ Evolution/ France/ Lathyrus sylvestris Leaves/ Plant development/ Protein/ Seed/ Seed proteins/ Taxonomy/ Tissue distribution/ reprint.

Singh, S. P. and Misra, B. K. (1986). **50 years of Lathyrus sativus research**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 240-245.
Source: reprintDE
Lathyrus sativus research history/ Lathyrus sativus/ France/ History/ Lathyrism/ Lathyrism history/ reprint.

Spencer, P. S. and Kaul. A. K. (1986). **INILSEL (International networks for the improvement of Lathyrus sativus and eradication of lathyrism). Outline and preliminary proposal**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 325-330.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ INILSEL/ reprint.

Spencer, P. S.; Ludolph, A. C.; Dwivedi, M. P.; Roy, D. N.; Hugon, J., and Schaumburg, H. H. (1986). **Lathyrism: Evidence for role of the neuroexcitory amino acid BOAA**. The Lancet **Nov.1986**:1066-1067
Source: reprintDE
NPAA toxicity/ ODAP toxicity/ Lathyrus sativus toxicity/ Lathyrism etiology/ Lathyrus sativus/ Amino acids/ Amino acids toxicity/ Lathyrism Lathyrism ODAP toxicity/ Lathyrus toxicity/ NPAA/ ODAP/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ reprint.

Spencer, P. S.; Roy, D. N.; Ludolph, A.; Hugon, J.; Dwivedi, M. P., and Schaumburg, H. H. (1986). **Lathyrism: evidence for role of the neuroexcitatory amino acid BOAA.** The Lancet **2** (8515):1066-1067
Lathyrism, a form of motorneuron disease induced by excessive consumption of the legume Lathyrus sativus (chickling pea), presents as signs of pyramidal tract involvement. Primate feeding studies show that beta-N-oxalylamino-L-alanine (BOAA), a potent neuroexcitatory amino acid in the chickling pea, induces corticospinal dysfunction similar to that seen in animals consuming a fortified diet of this legume. BOAA, a potent agonist of the excitatory neurotransmitter glutamate, is likely to be causally associated with lathyrism in man.
Source: Medline 87038378
Beta Alanine toxicity/ Adolescence/ Adult/ Child/ Disease Models Animal/ Lathyrism chemically induced/ Macaca fascicularis/ Alanine analogs and derivatives/ Central Nervous system drug effects/ Lathyrism physiopathology/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ Central Nervous system/ Diet/ Drugs/ Feeding/ Glutamates/ Lathyrism/ Lathyrism Adolescence/ Lathyrism animals/ Lathyrus toxicity/ Macaca/ Primates/ Humans/ Models/ Motor neurons/ Nervous system/ Neuroexcitatory Neurons/ Pyramidal tract/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Spencer, P. S.; Roy, D. N.; Palmer, V. S., and Dwivedi, M. P. (1986). **Lathyrus sativus L: The need for a strain lacking human and animal neurotoxic properties**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 297-305.
Source: reprintDE
ODAP/ Lathyrism/ Lathyrus sativus/ France/ Lathyrism animals/ Humans/ Neurotoxins/ Strains/ reprint.

Tiwari, O. P.; Agrawal, I., and Lal, M. S. (1986). **Studies on population densities in Lathyrus sativus L. in Madhya Pradesh, India**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 184-186.
Source: reprintDE
Lathyrus/ India L. sativus/ Madhya Pradesh L. sativus/ Lathyrus sativus/ France/ India/ India Madhya Pradesh/ India lathyrism/ Lathyrism Lathyrism India/ Madhya Pradesh/ Population/ reprint.

Toulemonde, C. and Vartanian, N. (1986). **Drought resistance of diploid and tetraploid cytotypes of Lathyrus pratensis L.** In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 187-196.
Source: reprintDE
Lathyrus pratensis/ Drought resistance L. pratensis/ Cytology L. pratensis/ Climate/ Cytology/ Drought/ Drought resistance/ France/ Resistance Tetraploid/ reprint.

Valero, M.; Youssef, A., and Vernet, P. (1986). **Is there polymorphism in the breeding system of Lathyrus latifolius?** Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 105-117.
Source: reprintDE
Lathyrus latifolius breeding polymorphism/ Polymorphism L. latifolius/ Breeding/ Genetics/ France/ Lathyrus latifolius/ Polymorphisms/ reprint.

Yamamoto, K.; Fujiware, T., and Blumenreich, I. D. (1986). **Isozymic variation and interspecific crossability in annual species of the genus Lathyrus**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 118-129.
Source: reprintDE
Lathyrus/ Lathyrus hierosolymitanus/ Lathyrus pseudocicera/ Lathyrus blepharicarpus/ Lathyrus marmoratus/ Lathyrus gorgonii/ Lathyrus hirsutus/ Lathyrus nissolia/ Lathyrus aphaca/ Lathyrus articulatus/ Interspecific hybridisation sect. Cicercula/ Isozymes L. sativus/ Isozymes L. hierosolymitanus/ Isozymes L. pseudocicera/ Isozymes L. blepharicarpus/ Isozymes L. marmoratus/ Isozymes L. gorgonii/ Isozymes L. cicera Isozymes L. odoratus/ Isozymes L. hirsutus/ Isozymes L. ochrus/ Isozymes L. tingitanus/ Isozymes L. clymenum/ Isozymes L. nissolia/ Isozymes L. aphaca/ Isozymes L. articulatus/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus ochrus/ Lathyrus clymenum/ Lathyrus tingitanus/ Lathyrus odoratus/ Isozymes/ Biochemistry/ Cicercula/ France/ Interspecific/ Interspecific hybridisation/ Lathyrism Biochemistry/ Lathyrism L. cicera Lathyrism L. clymenum/ Lathyrus gorgoni/ reprint.

Bisby, F. A.; Allkin, R.; Otto, B. A., and Almeida, M. T. (1987). **Genetic resources of medically important Vicieae (vetches and peas)**. In: Mota, M. and Baeta, J. (Eds). **International symposium on conservation of genetic resources of aromatic and medicinal plants, 9-11 May, 1984, Oeiras, Portugal**, Oeiras, Portugal: pp. 51-56. (author affiliation: Vicieae Database Project, Dep. Biol., Southampton Univ., SO9 5NH, UK).
The Vicieae Seed Collection of Southampton University, whose recent accessions have been mainly of seed collected from wild plants or seed multiplied from such sources, includes accessions of Vicia, Lathyrus, Lens and Pisum. The collection has been used to investigate the blood-group specific lectins produced by several Vicia species. Of the 8 accessions thought to be V. graminea (a source of anti-N lectins), 7 were tentatively identified as V. epetiolaris and only one as V. graminea. The collection has also been used to investigate lathyrism, a nervous disorder caused by excess 2-amino-3-oxalylaminopropionic acid from Lathyrus sativus seeds in the diet. Other Lathyrus species containing the neurotoxin are listed.
Source: Copyright CAB Abstracts (87-89) P716729
Lathyrus/ Gene banks/ UK/ Vicia/ Vicia graminea/ Plant composition/ Lectin/ Vicia epetiolaris/ Neurotoxins/ Lathyrus sativus/ Vicieae Agriculture/ Genetic resources/ Blood/ Conservation/ Databases/ Diet/ Genes/ Lens/ Medicinal/ Pisum/ Portugal/ Seed/ Wild.

Campbell, C. G. and Briggs, C. J. (1987). **Registration of low neurotoxin content Lathyrus germplasm LS 8246.** Crop Science **27** (4):821 (author affiliation: Agriculture Canada Research Station, Morden, Manitoba, R0G 1JO, Canada)
This L. sativus germplasm line is low in the neurotoxin beta-N-oxalyl-L-alpha-beta-diamino propionic acid (ODAP), a causal agent of the neurodegenerative disorder lathyrism. It was developed from a single plant of

Pusa 24, a low-ODAP line bred in India. ODAP concentration in seed of LS8246 ranged from 259 to 401 µg/g over 3 years, compared to 2615 µg/g for Pusa 24 in a single year.
Source: Copyright CAB Abstracts (87-89) P662114
Genetic resources releases/ Canada/ Plant composition/ Neurotoxins/ ODAP/ Lathyrus sativus/ Agriculture/ Genetic resources/ India/ India L. sativus/ India lathyrism/ India Lathyrus genetic resources/ Lathyrism/ Lathyrism India/ Manitoba/ Neurodegenerative/ Neurology/ Seed.

Choi, D. W. (1987). **Ionic dependence of glutamate toxicity**. Journal of Neuroscience **7**:369-379
ODAP/ Glutamates toxicity ionic influence/ ODAP toxicity ionic dependence/ Lathyrism/ Neurology/ Glutamates/ Glutamates toxicity Lathyrism ODAP toxicity/ Toxicity ODAP/ Toxicity.

Gupta, Y. P. (1987). **Anti nutritional and toxic factors in food legumes: a review.** Plant Foods for Human Nutrition **37** (3):201-228 (author affiliation: Division of Agricultural Biochemistry, Indian Agricultural Research Institute, New Delhi)
A comprehensive review on the presence of certain important anti-nutritional and toxic factors in food legumes has been conducted. These substances include proteolytic inhibitors, phytohemagglutinins, lathyrogens, cyanogenetic compounds, compounds causing favism, factors affecting digestibility and saponins. These factors are shown to be widely present in leguminous foods which are important constituents of the diet of a large section of the world's population, and particularly, of people in the developing countries.
Source: Medline 89184239
Cookery/ Favism etiology/ Glycosides adverse effects/ Hydrocyanic Acid adverse effects/ Lathyrism etiology/ Lectins adverse effects/ Protease Inhibitors adverse effects/ Saponins adverse effects/ Legumes adverse effects/ Biochemistry/ Nutritional value/ Antinutritional factors/ Protease inhibitor/ Agriculture/ Saponins/ Glycosides/ Delhi/ Diet/ Digestibility/ Favism/ Food/ India/ India Dietary/ Dietary/ India lathyrism/ Lathyrism Lathyrism Biochemistry/ Lathyrism India/ Lathyrism nutrition/ Lathyrism review/ Lathyrogens/ Humans/ Nutrition plant/ Nutrition/ Population Review.

Jha, K. (1987). **Effect of the boiling and decanting method of Khesari (Lathyrus sativus) detoxification, on changes in selected nutrients.** Archivos Latinoamericanos De Nutricion **37** (1):101-7 (author affiliation: College of Basic Sciences and Humanities, Rajendra Agricultural University, Pusa, Samastipur, India)
It is a well-known fact that the legume Khesari (Lathyrus sativus) causes lathyrism, a disease characterised by paralysis of the lower limbs in human beings. The toxic constituent is an amino acid identified as B-Oxalyl-Amino L-Alanine (BOAA). It has been reported that if the legume is boiled for two hours and the water is then decanted, almost 85% of the toxic amino acid is eliminated. Therefore, this investigation constitutes an effort to prevent the loss of other nutrients, simultaneously to the elimination of toxicity. As has been observed, as much as half the protein content, as well as 80.36% total sugars, 63.13% reducing sugars, 86.05% amino acids, and all thiamine, riboflavin and niacin are lost from dhal (dehulled, separated cotyledons), while the respective losses from the whole seeds are 47.25%, 45.73%, 74.69% and 80.00%, and all vitamins, in just a one-hour treatment. The losses of the toxic amino acid from dhal and whole seeds are 71.46% and 68.74%, respectively. The data for losses occurring in the two-hour and three-hour treatment are also described.
Source: reprintDE
Lathyrus sativus detoxification/ Lathyrus sativus nutritive value/ Processing L. sativus/ Toxicity/ ODAP/ Nutritional value/ Lathyrus sativus Agriculture/ Amino acids/ Cotyledons/ Detoxification/ Dhal/ India/ India L. sativus/ India lathyrism/ Khesari/ Lathyrism/ Lathyrism India Lathyrus toxicity/ Humans/ Nutrients/ Paralysis/ Processing/ Protein/ Protein content/ Riboflavin/ Seed/ Thiamine/ Toxicity ODAP/ Toxicity L. sativus/ Vitamins/ Water detoxification/ Water/ reprint/ Detoxification L. sativus/ Lathyrus sativus detoxification.

Lewin, R. (1987). **Environmental hypothesis for brain diseases strengthened by new data**. Research News.
Source: CGC_95_2
Lathyrism/ Incomplete/ Neurology/ Brain/ Brain diseases/ Environment.

Ludolph, A. C.; Hugon, J.; Dwivedi, M. P.; Schaumburg, H. H., and Spencer, P. S. (1987). **Studies on the aetiology and pathogenesis of motor neuron diseases. 1. Lathyrism: clinical findings in established cases.** Brain **110** (1):149-165
Lathyrism is a toxic disease of the motor system constantly associated with primary consumption of the seed of Lathyrus sativus (chickling or grass pea). Neurological examination was performed on 38 affected subjects drawn from four regions of the Indian subcontinent endemic for lathyrism. All showed a consistent and largely symmetric pattern of neurological deficit similar to that displayed by 5 Europeans with longstanding lathyrism now living in Israel. Hallmarks of lathyrism include a pyramidal pattern of motor weakness combined with greatly increased tone in the thigh extensors and adductors and in the gastrocnemius muscles so that the more severely affected walk on the balls of their feet with a lurching scissoring gait. Extensor plantar responses are uniformly present in such cases, and the knee and ankle tendon reflexes are exaggerated and often clonic. Hoffmann signs and exaggerated biceps and/or triceps tendon jerks are also found in the most severely affected. Sensory signs are absent, although perverse sensations in the legs are frequently

reported at the onset. Walking difficulties commonly begin suddenly but may also appear subacutely or insidiously. Some individuals experience partly reversible symptoms suggestive of a diffuse CNS excitation of somatic, motor and autonomic function.
Source: Medline 87101976; Reprinted with permission Copyright 1987 Macmillian Journals Ltd, UK
Adult/ Bangladesh/ Child/ India/ Lathyrism etiology/ Middle Age/ Muscles physiopathology/ Lathyrism physiopathology/ Motor neuron disorders etiology/ Neurology/ Lathyrus sativus/ Palestine/ Lathyrism symptoms/ Age/ Brain/ Central Nervous system/ Endemic/ Gait/ India L. sativus/ India L. sativus consumption/ India lathyrism/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism motor neurons/ Lathyrus toxicity/ Humans/ Motor neurons/ Muscles/ Nervous system/ Neurons/ Reflexes/ Seed/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity/ UK.

Mannan, M. A.; Haque, A., and Mohammad, Q. D. (1987). **Lathyrism [letter].** The Lancet **1** (8525):167
Source: Medline 87114353
Amino acids Diamino toxicity/ Lathyrism etiology/ Amino acids/ Lathyrism/ Toxicity.

Moslehuddin, A. B. M.; Hang, Y. D., and Stoewsand, G. S. (1987). **Evaluation of the toxicity of processed Lathyrus sativus seeds in chicks.** Nutrition Reports International **36** (4):851-855 (author affiliation: Dep. Food Science and Technology, Cornell Univ., Geneva, NY 14456, USA)
Lathyrus sativus seeds were processed for removal or destruction of their natural toxins. Partly purified concentrates from those seeds were injected intraperitoneally into 1-day-old male White Leghorn chicks as a bioassay of the effectiveness of the processing methods. When the raw seed concentrate was given to the chicks, they showed typical neurological signs such as head retraction, neck bending and stiffening followed by immediate death. Similar symptoms were observed in chicks injected with the concentrates of the seeds soaked overnight in water or in saturated calcium carbonate followed by steaming, autoclaving and fermenting at 30°C for 30 h. All chicks died within 4 h of treatment. There were 31% and 39% survivals with the concentrates of seeds soaked overnight in water followed by washing and steaming, and seeds soaked overnight in water followed by washing, steaming and fermenting at 30° for 30 h, respectively. Results from these chick bioassays showed that washing L. sativus seeds partly removes its neurotoxins. Fermentation, steaming or autoclaving seemed to have little effect on toxin removed.
Source: Copyright CAB Abstracts (87-89) N055865 reprintDE
Lathyrus sativus toxicity/ Bioassay chicks/ Poultry diseases/ Detoxification L. sativus/ Processing L. sativus/ Lathyrus sativus detoxification Antinutritional factors/ Lathyrus sativus/ Bioassay/ Agriculture/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Lathyrism symptoms/ Calcium Chickens/ Detoxification/ Evaluation/ Fermentation/ Food/ Food processing/ Food processing L. sativus/ Fowls/ Injections/ Lathyrism Lathyrism Bioassay/ Lathyrism nutrition/ Lathyrus toxicity/ Males/ Neurotoxins/ Nutrition animal/ Nutrition/ Poultry/ Processing/ Processing methods L. sativus/ Purification/ Reports/ Seed/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Toxin/ USA Water detoxification/ Water/ Reprint.

Nunn, P. B.; Seelig, M.; Zagoren, J. C., and Spencer, P. S. (1987). **Stereospecific acute neuronotoxicity of 'uncommon' plant amino acids linked to human motor system diseases.** Brain Research **410** (2):375-379
The L-isomer of beta-N-methylamino-L-alanine (BMAA), present in free form in seed of Cycas circinalis, elicits in spinal cord cultures a pattern of acute postsynaptic neuronal vacuolation comparable to that induced by beta-N-oxalylamino-L-alanine (BOAA), an excitotoxic amino acid of greater potency isolated from seed of Lathyrus sativus. The neuronotoxic properties of these compounds may be linked to the etiology of motor-system degenerative disorders (amyotrophic lateral sclerosis and lathyrism, respectively) found in human groups that have used these plant seeds for food.
Source: Medline 87243558; Reprinted with permission Copyright 1987 Elsevier Science B.V., Amsterdam, Netherlands
Beta Alanine toxicity/ Cells Cultured/ Mice/ Neuromuscular Diseases pathology/ Seed/ Spinal Cord pathology/ Alanine analogs and derivatives Amino acids Diamino toxicity/ Neuromuscular Diseases chemically induced/ Spinal Cord drug effects/ ODAP/ Rodents/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Brain/ Cycas/ Drugs Food/ Isomerism ODAP/ Isomerism/ Lathyrism/ Lathyrism etiology/ Lathyrism pathology/ Lathyrus toxicity/ Humans/ Neuromuscular/ ODAP isomerism/ Spinal cord/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Roman, G. C. (1987). **Tropical myelopathies and myeloneuropathies.** Bulletin of the Pan American Health Organization **21** (3):293-305 (author affiliation: Dep. Neurology, Texas Tech Univ., H.S.C. School of Medicine, Lubbock, TX 79439, USA)
Information available on known tropical myelopathies is reviewed and their main forms and features are described. The two main forms of tropical myelopathy are tropical ataxic neuropathy, a myeloneuropathy with prominent sensory ataxia, and tropical spastic paraparesis, a myelopathy with predominantly spastic paraplegia and minimal sensory deficit. These conditions arise from many causes associated with malnutrition, postinfectious tropical malabsorption, chronic cyanide intoxication from excessive cassava consumption, and lathyrism.
Source: Copyright CAB Abstracts (87-89) N072549 also published in Spanish in Boletin de la Oficina Sanitaria Panamericana (1986) 101, 452-462.

Nervous system diseases aetiology/ Nutrition/ Tropics/ Lathyrism/ Tropical myelopathies/ Tropical myeloneuropathies/ T Myelopathies Myeloneuropathies/ Neurology/ Famine/ Malnutrition/ Ataxia/ Australia/ Cyanides/ HCN/ Lathyrism nutrition/ Malabsorption/ Humans Manihot esculenta/ Cassava/ Myelopathy/ Nervous system/ Paraplegia/ Review/ Spain/ Spasticity/ Spastic paraparesis/ Spastic paraplegia/ USA Nervous system diseases.

Roman, G. C.; Schoenberg, B. S.; Madden, D. L., and et al. (1987). **Human T-lymphotrophic virus type 1 antibodies in the serum of patients with tropical spastic paraparesis in the Seychelles**. Arch. Neurol **44**:605-607
Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ HTLV/ Virology/ Antibodies/ Immunology/ Lathyrism/ Lathyrism serum/ Lathyrism viral infection/ Humans/ Spasticity Spastic paraparesis/ Tropics.

Ross, S. M.; Seelig, M., and Spencer, P. S. (1987). **Specific antagonism of excitotoxic action of 'uncommon' amino acids assayed in organotypic mouse cortical cultures.** Brain Research **425** (1):120-127 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, N.Y. 10461)
Beta-N-Methylamino-L-alanine (BMAA) and beta-N-oxalylamino-L-alanine (BOAA) are chemically related excitant amino acids present in the seeds of Cycas circinalis and Lathyrus sativus, respectively. Consumption of these seeds has been linked to Guam amyotrophic lateral sclerosis (BMAA) and lathyrism (BOAA) (a form of primary lateral sclerosis). We report that the acute neuronotoxic actions of these amino acids are blocked selectively by specific glutamate receptor antagonists. Administration of BOAA and BMAA to neonatal mouse cortex explants (EC100 = 28 microM and 1.6 mM, respectively) rapidly induces postsynaptic vacuolation (PSV) and neuronal degeneration characterized by dark/shrunken (D/S) cells. BOAA-mediated neuronotoxic effects are attenuated in a concentration-dependent manner by cis-2,3-piperidine dicarboxylic acid (PDA), an antagonist of quisqualate (QA)-preferring and kainate (KA)-preferring glutamate receptors. PDA maximally protected against BOAA-induced PSV by 84% at 1 mM and D/S cells by 80% at 0.5 mM. BMAA-induced cellular changes were antagonised selectively in a concentration-dependent manner by 2-amino-7-phosphono-heptanoic acid (AP7), an N-methyl-D-aspartate (NMDA) glutamate-receptor antagonist. AP7 maximally protected against BMAA-induced PSV and D/S by 88% at 1.0 and 0.5 mM, respectively. These protective actions were selective and specific since AP7 failed to attenuate BOAA-induced alterations, and PDA was ineffective in ameliorating BMAA-induced changes. Other glutamate receptor antagonists (glutamic diethyl ester and streptomycin) failed to protect the explants from the destructive action of either toxin. Taken collectively, our data indicate that the acute neuronotoxic actions of BOAA and BMAA (or a metabolite) operate through different glutamate receptor species.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: Medline 88108792; Reprinted with permission Copyright 1987 Elsevier Science B.V., Amsterdam, Netherlands
Beta Alanine antagonists and inhibitors/ Beta Alanine pharmacology/ Amino acids pharmacology/ Amino acids Diamino pharmacology/ Dose Response Relationship Drug/ Mice/ Mice Inbred Strains/ Neurotoxins pharmacology/ Osmolar Concentration/ Pipecolic Acids pharmacology Tissue Culture/ Alanine analogs and derivatives/ Amino acids Diamino antagonists and inhibitors/ Cerebral Cortex drug effects/ Neurotoxins antagonists and inhibitors/ Rodents/ NPAA/ ODAP toxicity/ Toxicity ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Antagonism amino acids/ Aspartic acid/ Brain Cerebral Cortex/ Cycas/ Drugs/ Glutamates/ Glutamates receptors/ Guam/ Kainic acid/ Lathyrism/ Lathyrism ODAP toxicity/ Lathyrus toxicity Neurotoxins/ NMDA/ NPAA rodents/ ODAP/ Pipecolic acid/ Receptors/ Reports/ Seed/ Strains/ Streptomycin/ Toxicity L. sativus/ Toxicity Toxin.

Ross, S. M. and Spencer, P. S. (1987). **Specific antagonism of behavioural action of 'uncommon' amino acids linked to motor system diseases.** Synapse **1** (3):248-253
Beta-N-methylamino-L-alanine (BMAA) and beta-N-oxalylamino-L-alanine (BOAA) are chemically related amino acids present in the seeds of Cycas circinalis and Lathyrus sativus, respectively. Consumption of these seeds has been linked to Guam amyotrophic lateral sclerosis (BMAA) and lathyrism (BOAA; a form of primary lateral sclerosis). A single large dose of BOAA or BMAA causes seizures in newborn mice and postsynaptic neuronal oedema and degeneration in CNS explants. We report that the acute neurotoxic actions of these amino acids are blocked selectively by specific glutamate-receptor antagonists (administered intracerebroventricularly) (i.c.v.) prior to the amino acid. Administration of BOAA i.c.v. to neonatal mice (ED100 = 50 micrograms) elicits a spectrum of time-dependent behavioural states including arm and leg rigidity, convulsions, and resting tremor. These are blocked in a dose-dependent manner by cis-2,3-piperidine dicarboxylic acid (PDA), an antagonist of quisqualate (QA)-preferring (A2) and kainate (KA)-preferring (A3) glutamate receptors (ED50s; 2.8 micrograms, rigidity; 1.4 micrograms, convulsions; 2.4 micrograms, resting tremor). BMAA induces a transitory hyperexcitable state followed by a long-lasting whole-body shake/wobble (ED100 = 1,000 micrograms, i.c.v.). These responses are antagonised selectively and dose-dependently by 2-amino-7-phosphonoheptanoic acid (AP7), an N-methyl-D-aspartate (NMDA) or A1 glutamate-receptor antagonist (ED50 = 0.45 microgram). Taken collectively, our data indicate that the acute neuronotoxic actions

of BOAA and BMAA (or a metabolite) operate through different glutamate-receptor species. BMAA likely exerts most of its action indirectly via the A1 glutamate receptor, while BOAA acts principally at the A2 and or A3 receptor.
Source: Medline 89100770
Beta Alanine pharmacology/ Amino acids administration and dosage/ Amino acids Diamino pharmacology/ Cerebral Ventricles drug effects Dose Response Relationship Drug/ Injections Intraventricular/ Mice/ Pipecolic Acids pharmacology/ Reference Values/ Amino acids pharmacology/ Cerebral Ventricles physiology/ Motor Activity drug effects/ Rodents/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Antagonism amino acids/ Aspartic acid Central Nervous system/ Convulsions/ Cycas/ Drugs/ Glutamates/ Glutamates receptors/ Guam/ Injections/ Kainic acid/ Lathyrism/ Nervous system/ Neurotoxins/ NMDA/ Oedema/ Physiology not plant/ Pipecolic acid/ Receptors/ Reports/ Seed.

Spencer, P. S. (1987). **Guam ALS/parkinsonism dementia: a long latency neurotoxic disorder caused by 'slow toxin(s)' in food?** Canadian Journal of Neurological Sciences **14** (3 Suppl):347-357 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, N.Y. 10461)
Parkinsonism (P) with progressive dementia (D) of the Alzheimer type is recognized as a clinical variant of a form of amyotrophic lateral sclerosis (ALS) that has occurred in high incidence among the Chamorro people of the islands of Guam and Rota in the Marianas chain of Micronesia. The declining annual incidence, upward shifting of the age of onset, narrowing of the sex ratio, and occurrence of the disease among non-Chamorros, point to a disappearing environmental causation peculiar to the traditional culture of these islands. Evidence is presented in support of the proposal that heavy use of certain toxic plants, notably cycads, a traditional source of food and medicine for the Chamorro people, plays an important aetiological role. Clinical and epidemiological approaches are offered to test for a relationship between ALS/P-D and long-latency plant toxicity.
Source: Medline 88052270
Alzheimer's Disease etiology/ Alzheimer's Disease physiopathology/ Amyotrophic Lateral Sclerosis etiology/ Amyotrophic Lateral Sclerosis physiopathology/ Guam/ Lathyrism physiopathology/ Neurotoxins adverse effects/ Parkinson Disease Symptomatic chemically induced Parkinson Disease Symptomatic physiopathology/ Alzheimer's Disease epidemiology/ Amyotrophic Lateral Sclerosis epidemiology/ Diet Parkinson Disease Symptomatic epidemiology/ Plants Toxic/ Toxicity/ Neurology/ Age/ Amyotrophic lateral sclerosis/ Environment Epidemiology lathyrism/ Food/ Incidence/ Lathyrism/ Lathyrism epidemiology/ Lathyrism etiology/ Neurotoxins/ Sex/ Toxic plants/ Toxin.

Spencer, P. S.; Hugon, J.; Ludolph, A. C.; Nunn, P. B.; Ross, S. M.; Roy, D. N., and Schaumburg, H. H. (1987). **Discovery and partial characterization of primate motor system toxins**. Ciba Found Symp, Vol. 126, pp. 221-238. ISBN: ISSN 0300-5208.
beta-N-Oxalylamino-L-alanine (BOAA) and beta-N-methylamino-L-alanine (BMAA) are chemically related excitant amino acids isolated from the seed of Lathyrus sativus (BOAA) and Cycas circinalis (BMAA), consumption of which has been linked to lathyrism (an upper motor neuron disorder) and Guam amyotrophic lateral sclerosis (ALS), respectively. Both diseases are associated with degeneration of motor neurons. Experimentally, single doses of BOAA or BMAA induce seizures in neonatal mice and postsynaptic neuronal oedema and degeneration in explants of mouse spinal cord and frontal cortex. Preliminary studies show that these behavioural and pathological effects are differentially blocked by glutamate-receptor antagonists. In macaques, several weeks of daily oral doses of BOAA produce clinical and electrophysiological signs of corticospinal dysfunction identical to those seen in comparably well-nourished animals receiving a fortified diet based on seed of Lathyrus sativus. By contrast, comparable oral dosing with BMAA precipitates tremor and weakness, bradykinesia and behavioural changes, with conduction deficits in the principal motor pathway. BOAA and BMAA (or a metabolite thereof) are the first members of the excitotoxin family to have been shown to possess chronic motor-system toxic potential. These observations provide a rational basis for searching for comparable endogenous neurotoxins in sporadic and inherited forms of human motor neuron disease.
Source: Medline 87217798
Lathyrism etiology/ Macaca/ Neuromuscular Diseases etiology/ Alanine analogs and derivatives/ Amino acids Diamino poisoning/ Motor Neurons/ Neuromuscular Junction drug effects/ Neurons drug effects/ ODAP/ NPAA toxicity/ Rodents/ Neurology/ Antinutritional factors Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amino acids toxicity/ Amyotrophic lateral sclerosis/ Cycas/ Diet/ Drugs/ Endogenous/ Frontal cortex/ Glutamates/ Guam/ Lathyrism/ Lathyrism animals/ Lathyrism motor neurons Lathyrus toxicity/ Primates/ Humans/ Mice/ Motor neurons/ Neuromuscular/ Neurons/ Neurotoxins/ NPAA/ NPAA rodents/ Oedema Receptors/ Seed/ Spinal cord/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Toxin.

Spencer, P. S.; Ross, S. M.; Nunn, P. B.; Roy, D. N., and Seelig, M. (1987). **Detection and characterization of plant derived amino acid motorsystem toxins in mouse CNS cultures.** Prog Clin Biol Res **253**:349-361
Source: Medline 88125156
beta Alanine pharmacology/ Beta Alanine toxicity/ Cell Survival drug effects/ Cells Cultured/ Central Nervous system drug effects/ Central Nervous system pathology/ Mice/ Neurons drug effects/ Alanine analogs and derivatives/ Central Nervous system cytology/ Lathyrism chemically induced/ Neuromuscular Diseases chemically induced/ Neurons cytology/ Neurotoxins pharmacology/ Plants Toxic/ Rodents Antinutritional factors/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ Cytology/ Drugs/ Lathyrism/ Lathyrism pathology/ Nervous system/ Neurology/ Neuromuscular/ Neurons/ Neurotoxins/ Survival/ Toxicity/ Toxin.

Agid, Y.; Pertuiset, B., and Dubois, B. (1988). **Motoneuron disease as manifestation of lupin seed toxicity [letter].** The Lancet **1** (8598):1347
Source: Medline 88232059
Lathyrism Alkaloids adverse effects/ Lathyrism etiology/ Neuromuscular Diseases/ Neuromuscular diseases Lathyrus/ Toxicity/ Alkaloids Lathyrism/ Lathyrus toxicity/ Lupinus/ Motor neurons/ Neuromuscular/ Neurology/ Neurons/ Seed.

Arya, L. S.; Qureshi, M. A.; Jabor, A., and Singh, M. (1988). **Lathyrism in Afghanistan.** Indian Journal of Pediatrics **55** (3):440-442
Source: Medline 89138569
Afghanistan lathyrism/ Lathyrism Afghanistan/ Lathyrism Adolescence/ Adolescent lathyrism/ Afghanistan/ India/ India lathyrism/ Lathyrism Lathyrism India.

Briggs, C. J. (1988). **Analysis of b-N-oxalylamino-L-alanine**. Paper Presented at the Conference on Lathyrus Sativus L and the Eradication of Lathyrism 2-6 May 1988 London, UK (Ciba Foundation, London)
ODAP analysis/ Lathyrus sativus/ ODAP/ UK.

Chowdhury, S. D. (1988). **Lathyrism in poultry: a review.** World's Poultry Science Journal **44** (1):7-16 (author affiliation: Division of Biochemistry and Physiology, Wye College, Univ. London, Wye, Ashford, Kent TN25 5AH, UK)
The effects on poultry of the toxic constituents of legume seeds of the genus Lathyrus which give rise to lathyrism in humans and experimental animals are reviewed and discussed. The limited amount of information available indicates that the toxic effects depend mainly on the species and age of birds, the amount of toxins absorbed, the route of administration and the duration of exposure. Seeds of Lathyrus species (a low cost protein source) could be utilised to a greater extent in poultry diets provided safe inclusion levels were established and ways of improving feed value estimated and applied. With regard to safety margins, the results of a recent study using laying fowls suggest that the seeds of certain species contain sufficiently low concentrations of toxins for them to be used without any deleterious effects on egg production or egg shell quality.
Source: reprintDE
Lathyrus/ Toxicity/ Poultry/ Lathyrism/ Leguminosae/ Seed/ Poisonous plants/ Biochemistry/ Nutritional value/ Antinutritional factors Agriculture/ Age/ Diet/ Egg production/ Eggs/ Feed/ Feed value/ Fowls/ Lathyrism animals/ Lathyrism Biochemistry/ Lathyrism review Lathyrus toxicity/ Layers/ Humans/ Physiology not plant/ Protein/ Quality/ Review/ Toxin/ UK/ reprint.

Chowdhury, S. D. and Davis, R. H. (1988). **Lathyrism in laying hens and increases in egg weight.** Veterinary Record **123**:272-275
Source: reprintDE
Osteolathyrogens poultry/ Egg weight beta aminopropionitrile toxicity/ Toxicity Osteolathyrism/ Osteolathyrism/ Agriculture Aminopropionitriles/ Eggs/ Lathyrism veterinary/ Layers/ Poultry/ BAPN/ Toxicity beta aminopropionitrile/ Toxicity/ reprint.

Dumas, M.; Giordano, C.; Ndiaye, I. P.; Hugon, J.; Vallat, J. M., and Sonan, T. (1988). **Le concept de neuro-myelopathie tropicale. [The concept of tropical neuromyelopathy].** Bull. Soc Pathol Exot Filiales **81** (2):183-188 (author affiliation: Institut d'Epidemiologie Neurologique et de Neurologie Tropicale, Faculte de Medecine, Limoges)
Since the beginning of this century, the concept of tropical neuromyelopathy (T. N. M.) was progressively elaborated in tropical areas. This disorder is constituted by three main clinical syndromes (e.g.: polyneuropathy, spastic paraplegia, ataxia). Abnormal clinical, electrophysiological and pathological features, observed in all clinical forms argue in favor of a diffuse pathobiological process of the nervous system. The association with positive HTLV-1 serology, has recently induced a great interest for the spastic forms of T. N. M. Tropical spastic paraplegia tend to be individualised. This attitude differs from the global concept of T. N. M. which allows gathering similar clinical syndromes. This T. N. M. group should be kept intact until the discovery of new aetiology. Toxic (manioc, lathyrism) or deficiency (hypovitaminosis, malabsorption) causes are incriminated. Otherwise aetiology are unknown.
Source: Medline 88327978; Reprinted with permission Copyright 1988 Masson S.A. Paris, France
Ataxia etiology/ Muscle Spasticity/ HTLV Infections complications/ Nervous system diseases etiology/ Paraplegia etiology/ Ataxia/ Australia Deficiency/ France/ HTLV/ Infection/ Lathyrism/ Lathyrism complications/ Lathyrism etiology/ Lathyrism viral infection/ Malabsorption Muscles/ Nervous system/ Neurology/ Paraplegia/ Spasticity/ Spastic paraplegia/ Syndrome/ Tropics/ Nervous system diseases.

Hugon, J.; Ludolph, A. C.; Roy, D. N.; Schaumburg, H. H., and Spencer, P. S. (1988). **Studies on the etiology and pathogenesis of motor neuron diseases. II. Clinical and electrophysiologic features of pyramidal dysfunction in macaques fed Lathyrus sativus and IDPN.** Neurology **38** (3):435-442 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, NY 10461)

A primate model of lathyrism has been produced in well-nourished male cynomolgus monkeys chronically fed a fortified diet composed of Lathyrus sativus (chickling or grass pea) and given daily per os an alcoholic extract of this legume. Animals given a diet of non-neurotoxic Cicer arietinum (chick pea) cross-matched with the nutritional properties of the experimental diet served as controls. Another group of animals received the same diet and oral doses of beta, beta'-iminodipropionitrile (IDPN), a reference compound that has been termed an 'experimental neurolathyrogen.' Monkeys fed Lathyrus developed clinical and electrophysiologic evidence of corticospinal deficits after 3 to 10 months of feeding. Animals administered IDPN showed clinical and/or electrophysiologic changes in the PNS and CNS motor and sensory pathways, and signs of cerebellar dysfunction. Since the two primate disorders are separable on clinical and electrophysiologic grounds, further use of the term 'experimental neurolathyrogen' to describe the neurotoxic properties of IDPN seems inappropriate. These findings demonstrate the feasibility of developing a model of early human lathyrism in adequately nourished nonhuman primates.
Source: 88157140
Electrophysiology/ Lathyrism physiopathology/ Macaca fascicularis/ Motor Activity drug effects/ Motor Activity physiology/ Muscles physiopathology/ Neuromuscular Diseases physiopathology/ Diet/ Legumes/ Motor Neurons/ Neuromuscular Diseases etiology/ Nitriles poisoning/ Pyramidal Tracts physiopathology/ Lathyrism primate model/ Neurology/ Lathyrus sativus/ Central Nervous system/ Chickens/ Cicer arietinum/ Drugs/ Feeding/ Lathyrism/ Lathyrism animals/ Lathyrism etiology/ Lathyrism motor neurons/ Macaca/ Primates/ Males/ Humans Models/ Motor neurons/ Muscles/ Nervous system/ Neuromuscular/ Neurons/ Neurotoxins/ Nitriles/ Physiology not plant/ Primate model lathyrism/ Pyramidal tract.

Lambein, F. (1988). **Chemistry and biochemistry of Lathyrus sativus**. Presented at the Conference on Lathyrus Sativus and Eradication of Lathyrism. 2-6 May 1986, London, U.K. (Ciba Foundation London.)
Lathyrus sativus chemistry/ Lathyrus sativus biochemistry/ Biochemistry L. sativus/ Chemistry L. sativus/ Phytochemistry L. sativus/ Lathyrus sativus/ Chemistry/ Lathyrism/ Lathyrism Biochemistry/ Phytochemistry.

Lowgren, M. (1988) **Studies on protein quality in legumes with special reference to factors interfering with protein utilisation and digestibility of brown beans (Phaseolus vulgaris L.)** [FILDR thesis]. Uppsala: University of Uppsala, Sweden, 46 pp.
Legumes, which contribute about 20% of the daily protein needs of an adult, contain a number antinutritional substances. The thesis deals with the effect of the antinutritional factors lectins (haemagglutinins), trypsin inhibitors and tannins on the digestibility and utilisation of proteins in legumes, especially brown beans (Phaseolus vulgaris L.) and the effect of processing e.g. soaking, heat treatment and sprouting The complementary effect of proteins from the lathyrism causing legume khesari dhal (Lathyrus sativus) in cereal-based weaning diets resulted in high true digestibility (TD). The antinutritional substances lectins and trypsin inhibitors, were inactivated when the temperature reached above 80$\sp\circ$C during boiling as well as during slow cooking of brown beans. Soaking had no effect on the biological value (BV), TD or net protein utilisation (NPU) of yellow peas (Pisum sativum sens. ampl. (L.) Govorov), soybeans (Glycine max (L.) Merr) or brown beans when evaluated on rats. Heat treatment improved BV, TD and NPU in soybeans and brown beans but not in yellow peas. Sulphur amino acid supplementation improved the BV and NPU in raw yellow peas and soybeans The digestibility of brown bean and casein based diets decreased when lectins and hull, which contain tannins, were added Brown beans sprouted for 10 d, showed gradually decreasing haemagglutinating and trypsin inhibitor activities, to approximately 10% of the original activity. This implies that high activities remain after 4 d, which is a common sprouting time. However, sprouting of chick peas (Cicer arietinum L.) and mung beans (Vigna radiata (L.)), both containing low levels of antinutrients, did not improve BV, TD and NPU.
Antinutritional factors heat treatment/ Antinutritional factors sprouting/ Lathyrus sativus nutritive value/ Nutritive value L. sativus/ Lectin Nutritional value/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Polyphenols/ Tannins/ Lathyrus sativus/ Amino acids/ Chickens Cicer arietinum/ Cookery/ Dhal/ Diet/ Digestibility/ Glycine max/ Heat/ Heat treatment/ Khesari/ Lathyrism/ Lathyrism rats/ Vigna radiata Phaseolus vulgaris/ Pisum sativum/ Processing/ Protein/ Protein quality/ Quality/ Rats/ Rodents/ Soaking/ Sulfur/ Sulfur amino acids/ Sweden Temperature/ Uppsala/ Utilisation/ Vigna.

Maru, M.; Getahun, A., and Hoshna, S. (1988). **Prevalence of paralytic poliomyelitis in rural and urban populations in Ethiopia: report of a house to house survey.** American Journal of Tropical Medicine and Hygiene **38** (3):633-635 (author affiliation: Gondar College of Medical Sciences, Gondar Regional Health Department, Ethiopia)
A house-to-house survey was carried out to determine the prevalence of poliomyelitis. During the survey 37,219 households were visited and 17,941 children 5-9 years old were found. Of 231 lame children, lameness compatible with paralytic poliomyelitis was found in 131, of these 91% had their condition before the age of 3 years. Nineteen percent needed a stick support for walking while 12% were unable to walk even with support. This problem was more common in rural populations. The prevalence of paralytic poliomyelitis was 7.3/1,000 children 5-9 years old.

Source: Medline 90365114; Reprinted with permission Copyright 1988 American Journal of Tropical Medicine and Hygiene
Cerebral Palsy complications/ Child/ Ethiopia epidemiology/ Lathyrism complications/ Paralysis congenital/ Paralysis etiology/ Poliomyelitis complications/ Prevalence/ Rural Population/ Urban Population/ Wounds and Injuries complications/ Paralysis epidemiology/ Poliomyelitis epidemiology/ Age/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ Lathyrism epidemiology/ Lathyrism Ethiopia/ Lathyrism etiology/ Humans Paralysis/ Population/ Reports/ Rural/ Surveys/ Tropical medicine/ Tropics.

Roy, D. N. (1988). **The neurotoxic disease lathyrism**. National Medical Journal of India **1**:70-80
Lathyrism review/ Neurology/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Neurotoxins/ Review.

Ryberg, B.; Blomberg, J., and Klasse, P. J. (1988). **Tropical spastic paraparesis associated with human T-lymphotropic virus type 1 in an East African naturalised in Sweden**. British Medical Journal **195**:1380
Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ HTLV/ Virology/ Lathyrism/ Lathyrism viral infection/ Humans/ Spasticity/ Spastic paraparesis/ Sweden/ Tropics.

Singh, N. K. (1988). **Lathyrism - a spreading malaise**. India Today **13** (March 31):179-181
Source: ref ex Lal and Swarup (1989)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Valdivieso, R.; Quirce, S., and Sainz, T. (1988). **Bronchial asthma caused by Lathyrus sativus flour.** Allergy **43** (7):536-539 (author affiliation: Servico de Alergia, Hospital Ramon y Cajal, Madrid, Spain)
A 10-year-old child with asthmatic attacks related to Lathyrus sativus flour inhalation was studied in our department. Skin test and specific bronchial provocation challenge were positive. Specific IgE antibodies to Lathyrus sativus flour was demonstrated by indirect enzyme immunoassay. We suggest that our patient's allergic symptoms were due to the development of Type I allergic reactivity to L. sativus antigens.
Source: Medline 89164709; Reprinted with permission Copyright 1988 Munksgaard International Publishers Ltd., Copenhagen
Lathyrus sativus bronchial asthma/ Bronchial Provocation Tests asthma L. sativus/ Immunoenzyme Techniques/ Lathyrism etiology/ Skin Tests Asthma etiology/ Hypersensitivity Immediate/ Legumes adverse effects/ Lathyrus sativus/ Lathyrism symptoms/ Allergy/ Antibodies/ Antigens Asthma/ Child/ Enzymes/ Flour/ Immunology/ Lathyrism/ Lathyrism Spain/ Humans/ Skin/ Spain/ Spain L. sativus/ Symptoms lathyrism.

Abegaz, B. M.; Kebede, N., and Asmelash, S. (1989). **HPLC analysis of beta-N-oxalylamino-L-alanine, the neurotoxin in the legume Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 128-132. (author affiliation: Department of Chemistry, Addis Ababa University, P.O.Box 1176, Addis Ababa, Ethiopia).
A method has been developed, using high performance liquid chromatography, for the analysis of beta-N-oxalyl-L-alanine (BOAA), the neurotoxic substance found in the legume Lathyrus sativus. Derivatization is not employed. It is possible to detect BOAA in the extract of one seed of L. sativus using this method. We have also been able to detect another neurotoxic component, beta-N-methylamino-L-alanine (BMAA) from the seeds of Cycas circinalis. 13C NMR data has also been generated for both compounds.
Source: reprintDE
Chemistry/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Chromatography/ Cycas/ Ethiopia/ HPLC HTLV/ Lathyrism Ethiopia/ Lathyrism viral infection/ Neurotoxins/ NMR/ ODAP/ ODAP analysis/ Seed/ reprint.

Barat, G. K.; Ghose, C., and Singh, J. (1989). **Methods for the estimation of BOAA**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 122-127.
Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ ODAP/ reprint.

Bashir, M. (1989). **Status of Lathyrus sativus in Pakistan**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 175-178.
Source: reprintDE
Pakistan/ INILSEL/ Pakistan L sativus/ Lathyrus sativus Pakistan/ Lathyrus sativus/ reprint.

Bekele, A. (1989). **Nutritional situation in Ethiopia: Potential for Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 191-197.

Source: reprintDE
INILSEL/ Lathyrus sativus human consumption/ Nutrition L sativus/ Ethiopia nutrition/ Ethiopia L sativus/ Lathyrus sativus Ethiopia Lathyrus sativus/ Ethiopia/ Human consumption/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism nutrition/ Humans/ Nutrition/ reprint.

Bell, E. A. (1989). **Lathyrus neurotoxin: History and overview**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 86-88.
Source: reprintDE
INILSEL/ Lathyrus toxicity review/ Review Lathyrus toxins/ Antinutritional factors/ Lathyrus sativus/ History/ Lathyrism/ Lathyrism history Lathyrism review/ Lathyrus toxicity/ Neurotoxins/ Review/ Toxicity L. sativus/ Toxicity/ Toxin/ reprint.

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Source: reprintDE
INILSEL/ Lathyrus sativus production/ Lathyrus sativus cultivation/ Lathyrus sativus Nepal/ Nepal L sativus production/ Genetic resources L sativus Nepal/ Lathyrus sativus/ Agriculture/ Genetic resources/ Cultivation/ Nepal/ Screening/ reprint.

Bridges, R. J.; Kadri, M. M.; Monagham, D. T.; Nunn, P. B.; Watkins, J. C., and Cotman, C. W. (1989). **Inhibition of 3H-AMPA binding by the excitotoxin beta-oxaly-L-alpha,beta-diaminopropionic acid**. European Journal of Pharmacology **145**:357-359
ODAP toxicity/ Biochemistry lathyrism/ AMPA receptors/ Lathyrism/ Lathyrism Biochemistry/ Lathyrism ODAP toxicity/ ODAP/ Receptors Toxicity ODAP/ Toxicity.

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Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ ODAP/ reprint.

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Source: reprintDE
INILSEL/ Lathyrus sativus improvement/ Lathyrus sativus development/ Lathyrus sativus/ reprint.

Campbell, C. G. (1989). **World germplasm resources of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 179-182.
Source: reprintDE
INILSEL/ Lathyrus sativus germplasm/ Genetic resources L sativus/ Lathyrus sativus/ Agriculture/ Genetic resources/ reprint.

Combes, D.; Delbos, M., and Regnault-Roger, C. (1989). **Genetic Resources of Lathyrus sativus in France**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 183-190.
Source: reprintDE
INILSEL/ France L. sativus/ Genetic resources L. sativus/ Lathyrus sativus/ Agriculture/ Genetic resources/ France/ reprint.

Debela, S. (1989). **Brief remarks on grass pea production in Ethiopia**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 147-151.
Source: reprintDE
INILSEL/ Lathyrus sativus production/ Ethiopia L. sativus production/ Lathyrus sativus/ Ethiopia/ Lathyrism Ethiopia/ reprint.

Dwivedi, M. P. (1989). **Epidemiological aspects of lathyrism in India**. Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the**

Improvement of Lathyrus sativus and the eradication of Lathyrism, New York: Third World Medical Foundation, pp. 1-16.
Source: reprintDE
INILSEL/ Lathyrism epidemiology/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Epidemiology lathyrism/ India/ India L. sativus Lathyrism/ reprint.

Hang, Y. D. (1989). **Post-production methods of vitamin supplementation of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 205-210.
Source: reprintDE
INILSEL/ Post harvest processing L. sativus/ Lathyrus sativus fermentation/ Lathyrus sativus/ Fermentation/ Lathyrism/ Postharvest/ Processing Vitamins/ reprint.

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Source: reprintDE
INILSEL/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrus sativus/ Bangladesh/ Lathyrism/ reprint.

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Source: Medline 89281699
India/ Lathyrism ethnology/ Nervous system diseases ethnology/ Neurology/ India lathyrism/ Lathyrism/ Lathyrism India/ Nervous system Neurolathyrism/ Nervous system diseases.

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Source: reprintDE
INILSEL/ Genetic resources Lathyrus/ Lathyrus sativus germplasm/ Lathyrus sativus/ Agriculture/ Genetic resources/ Storage/ Strategy/ reprint.

Kaul, A. K.; Hamid, M. A., and Akanda, R. U. (1989). **An agro-economic survey of two lathyrism-prone areas in Bangladesh**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 41-54.
Source: reprintDE
INILSEL/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrism socioeconomics/ Socioeconomics Bangladesh/ Bangladesh socioeconomics Economics/ Lathyrus sativus/ Bangladesh/ Lathyrism/ Lathyrism economics/ Surveys/ reprint.

Keenoy, P. M.; Urzay Iribarnegaray, C.; Quevedo Arechederra, M. A.; Urtusagasti Orue, G., and Brouard Urquiaga, J. M. (1989). **Latirismo y anestesia: a proposito de un caso. [Lathyrism and anesthesia: apropos of a case (letter)].** Rev Esp Anestesiol Reanim **36** (2):124
Source: Medline 89387799
Middle Age/ Anesthesia General/ Lathyrism physiopathology/ Neuromuscular Blocking Agents/ Age/ Lathyrism/ Neuromuscular.

Kisby, G. E.; Roy, D. N., and Spencer, P. S. (1989). **A sensitive HPLC method for detection of beta-N-oxalylamino-L-alanine in Lathyrus sativus and animal tissue**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 133-138.
Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ HPLC/ HTLV/ Lathyrism animals/ Lathyrism viral infection/ ODAP/ Tissue/ reprint.

Lal, M. S. and Swarup, I. (1989). **Socio-economic issues in relation to production and consumption of Lathyrus sativus in India**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 55-60.
Source: reprintDE
INILSEL/ Lathyrus sativus production/ Lathyrus sativus cultivation/ Lathyrus sativus socioeconomics/ Socioeconomics L. sativus/ Economics Lathyrus sativus/ Cultivation/ India/ India L. sativus/ India L. sativus consumption/ India L. sativus production/ India lathyrism/ Lathyrism Lathyrism economics/ Lathyrism India/ reprint.

Lambein, F. (1989). **Chemistry and biochemistry of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 61-75.
Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ Lathyrus sativus Isoxazolin-5-one/ Biochemistry L. sativus/ Chemistry L. sativus/ NPAA L. sativus Lathyrus sativus/ Isoxazolin-5-one/ Chemistry/ Lathyrism/ Lathyrism Biochemistry/ Lathyrus toxicity/ NPAA/ NPAA chemistry/ Toxicity L. sativus/ Toxicity/ reprint.

Nunn, P. B. (1989). **Lathyrus sativus toxins: Identification and possible mechanisms**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 89-96.
Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Mechanisms toxicity/ Review L. sativus toxicity Antinutritional factors/ Lathyrus sativus/ Lathyrism/ Lathyrism mechanisms/ Lathyrism review/ Lathyrus toxicity/ Review/ Toxicity/ Toxin reprint.

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Source: reprintDE
INILSEL/ Manifesto/ Lathyrus sativus research funding/ Lathyrus sativus/ reprint.

Pushpamma, P. (1989). **Post-production processing of Lathyrus sativus in India**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 198-204.
Source: reprintDE
INILSEL/ Lathyrus sativus detoxification/ Detoxification L. sativus/ Post harvest processing L. sativus/ India L. sativus/ Lathyrus sativus India Lathyrus sativus/ Detoxification/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Postharvest/ Processing/ reprint.

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Source: reprintDE
INILSEL/ Bangladesh L. sativus research/ Lathyrus sativus Bangladesh/ Lathyrus sativus/ Bangladesh/ Lathyrism Bangladesh/ reprint.

Rathod, K. L. (1989). **Status of Lathyrus sativus in India with special reference to Madhya Pradesh**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 168-174.
Source: reprintDE
INILSEL/ India L. sativus/ Lathyrus sativus India/ Lathyrus sativus Madhya Pradesh/ Madhya Pradesh L. sativus/ Lathyrus sativus/ India India Madhya Pradesh/ India lathyrism/ Lathyrism/ Lathyrism India/ Madhya Pradesh/ reprint.

Riley, K. W. (1989). **Lathyrus improvement: IDRC support**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 211-217.
Source: reprintDE
INILSEL/ Lathyrus sativus research funding/ Lathyrus sativus/ reprint.

Ross, S. M. and Spencer, P. S. (1989). **Beta-N-oxalylamino-L-alanine: Potential mechanisms of neurotoxicity**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 97-108.
Source: reprintDE

INILSEL/ ODAP toxicity/ ODAP toxicity mechanism/ Toxicity L. sativus mechanisms/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Lathyrism/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Mechanisms toxicity/ Neurotoxicity/ ODAP Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ reprint.

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Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ ODAP toxicity/ Amino acid composition L. sativus/ Lathyrus sativus/ Amino acids/ Amino acid composition/ Lathyrism/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Neurotoxins/ ODAP/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity reprint.

(1989). Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation.
Source: reprintDE
INILSEL/ Lathyrus sativus/ reprint.

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Source: reprintDE
INILSEL/ Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrus sativus/ Ethiopia/ Lathyrism/ reprint.

Weiss, J. H.; Koh, J.-Y., and Choi, D. W. (1989). **Neurotoxicity of ß-N-methylamino-L-alanine(BMAA) and ß-N-oxalylamino-L-alanine(BOAA) on cultured cortical neurons**. Brain Research **497**:64-71.
Recent studies have implicated the ingestion of the structurally related plant excitotoxins, beta-N-methylamino-L-alanine (BMAA), and beta-N-oxalylamino-L-alanine (BOAA), in the pathogenesis of two human motor system diseases, the amyotrophic lateral sclerosis-Parkinsonism-dementia complex of Guam (Guam ALS-PD), and lathyrism, respectively. We have investigated the toxicity of these amino acids on cultured mouse cortical neurons in the presence of physiological concentrations of bicarbonate (a required toxic cofactor for BMAA neurotoxicity). A 24 h exposure to 10 microM - 3 mM BMAA, or to 300 nM - 100 microM BOAA, induced, concentration-dependent neuronal degeneration without glial damage; the neurotoxic EC50 for BMAA was about 1 mM, and the EC50 for BOAA was about 20 microM. At high concentrations, both compounds destroyed essentially the entire neuronal population. Neurotoxicity also depended on exposure duration, with reduced injury at an exposure time of 1 h, and increased injury at an exposure time of 3 days. Despite the fact that ingestion of BMAA and BOAA both lead to motor system damage, previous studies have suggested that the two excitotoxins act primarily on different glutamate receptor subtypes: BMAA on N-methyl-D-aspartate (NMDA) receptors, and BOAA on non-NMDA receptors. Consistent with these studies, the neurotoxicity of high concentrations of BMAA was substantially attenuated by 1 mM D-amino-5-phosphonovalerate (D-APV), whereas BOAA neurotoxicity was less sensitive to D-APV but was attenuated by 2 mM kynurenate.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: reprintDE; reprinted with permission Copyright 1989 Elsevier Science B.V., Amsterdam, Netherlands
NPAA/ ODAP bioassay/ ODAP cortical neuron bioassay/ Lathyrus sativus toxicity/ Rodents/ Neurology/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Amino acids/ Amino acids toxicity/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Glutamates/ Glutamates receptors/ Guam/ Heavy metals/ Lathyrism/ Lathyrism Bioassay/ Lathyrus toxicity/ Humans/ Metals/ Mice/ Neurons/ Neurotoxicity/ Neurotoxins/ NMDA/ NPAA rodents/ ODAP/ Population Receptors/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity rodents bioassay/ Toxicity/ reprint.

Acharya, G. P. and Pathak, U. N. (1990). **A pilot study on lathyrism in eastern Terai of Nepal.** Journal of the Institute of Medicine (Nepal) **12** (3):233-239 (author affiliation: Dep. Med., TU Inst. Med. Nepal, Nepal)
A pilot study on Lathyrism in two districts of Eastern Terai of Nepal, Mohatari and Dhanusa, detected eight cases of Lathyrism. The study also collected information on cultivation and consumption pattern of Lathyrus sativus.
Source: Copyright Biological Abstracts (91)
Lathyrism/ Nepal L sativus/ Lathyrus sativus/ Cultivation/ Nepal.

Allen, C. N.; Ross, S. M., and Spencer, P. S. (1990). **Properties of the neurotoxic non-protein amino acids beta-N-methylamino-L-alanine (BMAA) and beta-N-oxalyamino-L-alanine (BOAA), in ALS**. In: Ross, F. C. and Norris, F. H. (Eds). **New Advances in Toxicology and Epidemiology**, London: Smith-Gordon, pp. 49-56.
Source: ref ex Roy (pers. comm.)

ODAP toxicity/ Lathyrism/ NPAA toxicity/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Epidemiology lathyrism/ Lathyrism epidemiology/ Lathyrism ODAP toxicity/ Neurotoxins/ NPAA/ ODAP/ Protein/ Toxicity ODAP/ Toxicity.

Meldrum, B. S. and Garthwaite, J. (1990). **Excitatory amino acid neurotoxicity and neurodegenerative disease**. Trends in Pharmacological Sciences **11**:379-387
Lathyrism/ ODAP/ Neurodegenerative disease/ Review/ Neurology/ Amino acids/ Amino acids reviews/ Excitatory amino acid/ Lathyrism review/ Neurodegenerative/ Neurotoxicity.

Murphy, T. H.; Schnaar, R. L., and Coyle, J. T. (1990). **Immature cortical neurons are uniquely sensitive to glutamate toxicity by inhibition of cystine uptake**. FASEB J **4**:1624-1633
Sulfur/ Lathyrism/ ODAP uptake/ Sulfur amino acid transport/ Toxicity/ Amino acids/ Cystine/ Glutamates/ Immaturity/ Neurology/ Neurons ODAP/ Sulfur amino acids/ Toxicity ODAP.

Nicolls, D. G. and Attwell, D. (1990). **The release and uptake of excitatory amino acids**. Trends in Pharmacological Sciences **11**:462-468
Lathyrism/ ODAP/ Neuroexcitatory amino acid uptake/ Neuroexcitatory amino acid release/ Amino acids/ Excitatory amino acid Neuroexcitatory.

Roy, B. C.; Naved, A. F.; Chowdhury, A. K. A., and Yusuf, H. K. M. (1990). **BOAA content of Lathyrus sativus varieties grown in Bangladesh.** Bangladesh Journal of Scientific Research **8** (1):49-58 (author affiliation: Dhaka Univ. (Bangladesh). Dept. of Biochemistry)
The toxin (BOAA, beta-N3 oxalylamino-L-alanine) contents of Lathyrus sativus (khesari) grown in different regions of Bangladesh (from Chittagong to Dinajpur and from Sylhet to Khulna) were measured by a standardized calorimetric method. The major varieties grown in Barisal, Charbadna, Jamalpur and Pahartali contained 486, 837, 540 and 527 mg BOAA per 100 g dried seed. Other values ranged from 552 mg/100 g at Bola and 570 mg/100 g at Khulna to 905 mg/100 g at Dinajpur and 973 mg/100 g at Rangpur. However, in Faridpur, the neighbouring district of Barisal or Khulna, the seed had a rather high value of 848 mg/100 g; on the other hand, in the Northern district of Bogra, which is near to Rangpur, the BOAA content was only 628 mg/100 g. In Rajshahi and Kushtia (regions known as the lathyrism pocket), the BOAA contents were 686 and 636 mg/100 g, respectively, values intermediate between those observed in seeds grown in Bola and Khulna, or Rangpur and Dinajpur. The data thus indicate that there is no clear-cut correlation between BOAA content of seeds grown in different regions of Bangladesh, nor does there exist any positive correlation between toxin content of Lathyrus seeds and the prevalence of lathyrism.
Source: CODIS 91-056470
ODAP L. sativus/ Lathyrus sativus ODAP/ Lathyrus sativus germplasm/ Lathyrus sativus Bangladesh/ Bangladesh L. sativus/ Lathyrism epidemiology/ Epidemiology lathyrism/ Biochemistry/ Lathyrus sativus/ Agriculture/ Genetic resources/ Beta Alanine analogs and derivatives Bangladesh/ Khesari/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism Biochemistry/ ODAP/ Prevalence/ Seed/ Toxin/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Genetic resources L. sativus.

Tekle Haimanot, R.; Abebe, M.; Gebre-Mariam, A.; Forsgren, L.; Holmgren, G.; Heijbel, J., and Ekstedt, J. (1990). **Community-based study of neurological disorders in rural central Ethiopia**. Neuroepidemiology **9**:263-277
Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrism epidemiology/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ Rural.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kalissa, A.; Alemu, T.; Zein, Z. A., and Spencer, P. S. (1990). **Lathyrism in rural Northwestern Ethiopia: a highly prevalent neurotoxic disorder.** International Journal of Epidemiology **19** (3):664-672 (author affiliation: Faculty of Medicine, PO Box 4147, Addis Ababa University, Ethiopia)
Lathyrism is a disorder of the central motor system, induced by heavy consumption of the grass-pea, Lathyrus sativus, an environmentally tolerant legume containing a neurotoxic excitatory amino acid. A complete door-to-door resurvey of the Dembia and Fogera regions of northwestern Ethiopia, areas endemic for lathyrism, revealed an estimated mean disease prevalence of 0.6%-2.9%. Most patients developed the disease in the epidemic of 1976/77, although new cases appear to have occurred with an estimated mean annual incidence of 1.7:10 000. Production and consumption of grass-pea is increasing in Ethiopia, making attempts to develop special strains to prevent lathyrism increasingly important.
Source: Copyright CAB Abstracts (90-91) R848142
East Africa/ Grain legumes/ Food consumption/ Ethiopia lathyrism/ Nervous system diseases/ Neurology/ Lathyrus sativus/ Africa/ Amino acids Endemic/ Epidemiology lathyrism/ Excitatory amino acid/ Food/ Pulses/ Lathyrism Ethiopia/ Incidence/ Lathyrism/ Lathyrism epidemiology Humans/ Nervous system/ Neurotoxins/ Prevalence/ Rural/ Strains/ Tolerance.

Young, A. B. and Fagg, G. E. (1990). **Excitatory amino acid receptors in the brain: membrane binding and receptor autoradiographic approaches**. Trends in Pharmacological Sciences **11**:126-133
Brain excitatory neuroreceptors/ Lathyrism/ ODAP receptors/ Neurology/ Amino acids/ Brain/ Excitatory amino acid/ Membranes/ ODAP Receptors.

Bridges, R. J.; Hatalski, C.; Shim, S. N., and Nunn, P. B. (1991). **Gliotoxic properties of the Lathyrus excitotoxin beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (beta L ODAP).** Brain Research **561** (2):262-268 (author affiliation: Department of Neurology, Irvine Research Unit on Brain Aging, University of California 92717 USA)

beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid (beta-L-ODAP) is an excitatory amino acid agonist found in the seeds of Lathyrus sativus that is believed to be the major causative agent in the pathology of human lathyrism. We have found that in addition to its previously recognized neurotoxic properties, beta-L-ODAP is also gliotoxic. When added to cultures of neonatal rat astrocytes, beta-L-ODAP induced a series of morphological changes (e.g., extensive vacuole formation, pale and swollen nuclei with obvious nucleoli, and cellular swelling) that led to the eventual lysis of the glial cells. If the beta-L-ODAP was removed prior to the lysis of the astrocytes, many of the early morphological changes appeared to be reversible. When quantitated by a loss of the lactate dehydrogenase activity, beta-L-ODAP lysed the astrocytes with an LD50 of 2.1 +/- 0.2 mM following 48 h of exposure. Lower concentrations of beta-L-ODAP were found to be more toxic if the duration of the exposure was increased. The results suggest that the overall impact of the toxin on the CNS may represent the cumulative action of beta-L-ODAP at a number of distinct points on both neurons and astrocytes. The potential that these multiple sites of action may affect the normal regulation of extracellular glutamate and, consequently, disturb the balance between its normal and pathological roles is discussed.

Source: Medline 92200206; Reprinted with permission Copyright 1991 Elsevier Science B.V., Amsterdam, Netherlands

Lathyrus sativus ODAP/ Animals Newborn/ Astrocytes drug effects/ Cell Survival drug effects/ Cells Cultured/ Molecular Structure/ Rats Structure Activity Relationship/ Amino acids Diamino pharmacology/ Astrocytes cytology/ Cerebral Cortex cytology/ Neurotoxins pharmacology/ Rodents/ ODAP/ NPAA/ ODAP toxicity/ Toxicity ODAP/ Neurology/ Lathyrus sativus/ Amino acids/ Astrocytes/ Brain California/ Central Nervous system/ Cerebral Cortex/ Cytology/ Drugs/ Excitatory amino acid/ Glutamates/ Lactate dehydrogenase/ Lactate Lathyrism/ Lathyrism animals/ Lathyrism ODAP toxicity/ Lathyrism pathology/ Lathyrism rats/ Lathyrus toxicity/ Humans/ Molecular Nervous system/ Neurons/ Neurotoxins/ NPAA rodents/ Nuclei/ Regulation/ Seed/ Survival/ Toxicity L. sativus/ Toxicity/ Toxin/ USA.

Deshpande, S. S. and Sathe, S. K. (1991). **Toxicants in plants**. In: Sharma, R. P. and Salunkhe, D. K. (Eds). **Mycotoxins and phytoalexins**, Boca Raton: CRC Press, pp. 671-730.

Naturally occurring antinutritional and toxic factors from important plant food sources are discussed. No attempt has been made to cover all known natural toxic substances from plants, and this review covers certain evolutionary, structural, biochemical, technological, nutritional and toxicological aspects of the most important antinutritional factors occurring in the human food chain. The main headings are: carbohydrates, proteins and amino acids, lipids and fatty acids, minerals, vitamins, antivitamins, proteinase inhibitors, amylase inhibitors, lipase inhibitors, lectins (phytohaemagglutinins), phytate, tannins (polyphenols), cyanogenic glycosides, glucosinolates, favism, lathyrism, toxic amino acids, saponins, steroidal alkaloids of potato, allergens, gossypol, safrole, oestrogens, oxalates, removal of antinutrients.

Source: Copyright CAB Abstracts (92) V682150

Toxicity/ Toxic substances/ Poisonous plants/ Plants/ Lectin/ Antinutritional factors/ Amylase inhibitor/ Polyphenols/ Tannins/ Phytoalexins Saponins/ Glycosides/ Mycotoxins/ Alkaloids/ Amylase/ Amino acids/ Amino acids reviews/ Carbohydrates/ Evolution/ Fats/ Fatty acids Favism/ Food/ HCN/ Lathyrism mycotoxins/ Lathyrism review/ Lipids/ Humans/ Mineral/ Oxalates/ Phytates/ Protein/ Review/ Toxic amino acids/ Vitamins.

Haque, A.; Hossain, M., and Wouters, G. (1991). **Epidemiological and clinical study of lathyrism in Bangladesh: preliminary report.** Bangladesh Journal of Neuroscience **7** (2):60-71

Source: Lambein_95_5

Bangladesh lathyrism/ Lathyrism Bangladesh/ Lathyrism epidemiology/ Neurology/ Bangladesh/ Epidemiology lathyrism/ Lathyrism/ Reports.

Hussain, M. (1991). **Future of Khesari cultivation in Bangladesh**. In: Kumar, J.; Sahni, B. B., and Usha Raman (Eds). **Advances in pulses research in Bangladesh. Proceedings of the second national workshop on pulses, 6-8 June 1989, Joydebpur, Bangladesh**, Patancheru, India: ICRISAT, pp. 183-189. (author affiliation: Bangladesh Agricultural Research Institute, Mymensingh, Bangladesh).

Khesari (Lathyrus sativus L.) in the most important pulse crop of Bangladesh. A strong epidemiological association is known to exist between human consumption of Khesari and the incidence of lathyrism. A toxin in its seed called -N-axalyl-L-, -diaminopropionic acid (ODAP) is believed to be the causative principle. About 6000 patients are affected by lathyrism in this country. Often malnourished young males are the victims. The area under khesari cultivation remains high because of its drought resistance, its minimal managerial requirement, and its protein-rich seeds. Of all the processing procedures, lime water is reported to remove the toxin from the seeds to a great extent. Vitamin C is reported to protect consumers from lathyrism. Attempts to develop a toxin-free cultivar have so far proved unsuccessful. Oxalyl derivatives of some amino acids as well as isoxazolinone dervatives were found in the synthesis of ODAP but its biosynthetic pathway is still not understood. This may in part offer an explanation for the unsuccessful search for toxin-free cultivars.

The search should continue for low-toxin lines with high seed yield, and for easy, effective procedures to remove the toxin before the seeds are consumed. Studies on the relationship between drought and salinity resistance and the -N-axalyl aminoalamine (BOAA) content may be carried out.
Source: P292937 ; reprintDE
Grain legumes/ Evaluation/ Bangladesh/ Composition/ ODAP/ Agronomy/ Forage/ Salinity/ Lathyrus sativus/ Isoxazolin-5-one/ Agriculture Amino acids/ Ascorbic acid/ Vitamin C/ Climate/ Cultivars/ Cultivation/ Drought/ Drought resistance/ Fodder/ Pulses/ Grain legumes Bangladesh/ Grain legumes India/ Human consumption/ Incidence/ India/ India L. sativus/ India L. sativus consumption/ India lathyrism Khesari/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism vitamin C/ Lathyrus sativus agronomy/ Lime/ Males/ Humans Processing/ Protein/ Resistance/ Seed/ Seed yield/ Toxin/ Vitamins/ Water/ Yield/ Yield fodder/ Yield L. sativus/ reprint.

Jubete, F. F. (1991). **Los Titarros. El cultivo de Lathyrus en Castilla y Leon. [Cultivation of Lathyrus sativus and L. cicera in Castilla and Leon, Spain)**. Junta de Castilla y Leon. Consejera de Agricultura y Ganaderia, 175 pp Coleccion de Estudios Agrarios No. 1. ISBN: 84-7939-011-5 (author affiliation: Prof. Fernando Franco Jubete, Esculea Tecnica Superior de Ingenierias Agrarias, Universidad de Valldolid, Avda. de Madrid, 57, ph: (979) 72 90 48 - 72 90 69, 34071 Palencia, Spain).
Titarro is the Spanish name for Lathyrus cicera. This publication is based on a study (1984 -1989) for a doctoral dissertation with the title 'Iniciacion a la seleccion de Lathyrus cicera L. en la provincia de Palencia' (1990) and provides a comprehensive treatise of Lathyrus spp. in the regions of Castilla and Leon, Spain, with particular emphasis on crop development of L. cicera, incl. botany, agronomy, genetic resources and their evaluation, breeding. It is interesting to note that cultivated L. cicera is frequently a mixture (semilla de comuna) of Vicia ervilia (yeros, ca 10%), V. sativa (vezas ca 3 %), barley (ca 21%) and other impurities (ca 13%). Date is not given in the publication.
Source: DE_96_9; reprintDE
Monograph L. cicera/ Lathyrus cicera monograph/ Lathyrus cicera Spain/ Spain L. cicera/ Spain Lathyrus spp/ Lathyrus spp Spain/ Vicia ervilia Vicia sativa/ Legume mixtures/ Lathyrism Spain/ Spain Lathyrism/ Mixtures communal/ Communal mixtures/ Semillas de comuna/ Traditional names/ Cultivation L. cicera/ Lathyrus cicera agronomy/ Lathyrus cicera climatic factors/ Lathyrus cicera cultivation/ Lathyrus cicera distribution/ Lathyrus cicera fodder value/ Lathyrus cicera feeding/ Lathyrus cicera intercropping/ Lathyrus cicera L./ Lathyrus cicera phenology/ Forage/ Lathyrus sativus/ Lathyrus cicera/ Agriculture/ Genetic resources/ Agronomy mixtures/ Hordeum/ Climate/ Cultivation/ Dissertations/ Distribution plants/ Evaluation genetic resources/ Feeding/ Fodder/ Intercropping/ Lathyrism/ Lathyrism L. cicera/ Lathyrus sativus agronomy/ Lathyrus spp/ Mixtures crops/ Monograph/ Phenology/ Landrace mixtures/ Spain/ Spain L. sativus/ Traditional names/ Vicia/ Genetic resources evaluation/ reprint.

Spencer, P. S.; Allen, C. N.; Kisby, G. E.; Ludolph, A. C.; Ross, S. M., and Roy, D. N. (1991). **Lathyrism and western Pacific amyotrophic lateral sclerosis: etiology of short and long latency motor system disorders.** Adv Neurol **56**:287-299 (author affiliation: Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University, Portland 97201)
Source: Medline 91306771
beta Alanine analogs and derivatives/ Amyotrophic Lateral Sclerosis chemically induced/ Amyotrophic Lateral Sclerosis physiopathology Lathyrism chemically induced/ Lathyrism physiopathology/ Nerve Degeneration/ Nervous system diseases chemically induced/ Nervous system diseases physiopathology/ Neuromuscular Diseases chemically induced/ Neuromuscular Diseases physiopathology/ Neurons drug effects/ Plants Toxicity/ Amyotrophic Lateral Sclerosis etiology/ Lathyrism etiology/ Neuromuscular Diseases etiology/ Neurology/ Beta Alanine analogs and derivatives/ Amyotrophic lateral sclerosis/ Drugs/ Environment/ Lathyrism/ Lathyrism nerve degeneration/ Nerves/ Nervous system Neuromuscular/ Neurons/ Oregon/ Toxicity/ Nervous system diseases.

Wadia, N. H. (1991). **Unusual degenerative and environmental diseases seen in India.** Mitteilungen Der Osterreichischen Gesellschaft Fur Tropenmedizin Und Parasitologie **13**:59-69 (author affiliation: Jaslok Hospital and Research Centre, Bombay, India)
Malnutrition and its effect on the nervous system and toxicity caused by consuming the legume Lathyrus sativus, leading to lathyrism, as seen in India is reviewed.
Source: Copyright CAB Abstracts (94-94.6) N583292
Deficiency diseases/ Lathyrus sativus malnutrition/ Malnutrition deficiency diseases/ Nervous system diseases malnutrition/ Malnutrition India Lathyrism/ Toxicity/ Famine/ Malnutrition/ Lathyrus sativus/ Deficiency/ Environment/ India/ India L. sativus/ India malnutrition/ India lathyrism/ Lathyrism India/ Lathyrus toxicity/ Humans/ Nervous system/ Neurology/ Toxicity L. sativus/ Nervous system diseases.

Campbell, C. G. (1992). **Genotypic characters for reduced neurotoxin content in Lathyrus sativus**. Lathyrus and Lathyrism Newsletter **4**:9-10
Source: reprintDE
Lathyrus sativus genetics/ Genetics L sativus/ Breeding/ ODAP genetics/ Genetics ODAP/ Lathyrus sativus/ Genetics/ Neurotoxins/ ODAP reprint.

Drory, V. E.; Rabey, M. J., and Cohn, D. F. (1992). **Electrophysiologic features in patients with chronic neurolathyrism.** Acta Neurologica Scandinavica **85** (6):401-403 (author affiliation: Department of Neurology, Tel-Aviv Sourasky Medical Center, Israel)
Neurolathyrism is a toxic nutritional disorder induced by the ingestion of the chick-pea 'Lathyrus sativus' and characterised by a pure motor spastic paraparesis. Eight patients with long-standing disease underwent nerve

conduction and electromyographic studies. Two of them (25%) showed electrophysiological signs of lower motor neuron disease in their lower limbs. Subclinical affection of the anterior horn cells occurs probably more frequently than expected in chronic neurolathyrism.
Source: Medline 92351736; Reprinted with permission Copyright 1992 Munksgaard Publishers, Copenhagen
Aged/ Electromyography/ Lathyrism diagnosis/ Muscles innervation/ Neurologic Examination/ Peripheral Nerve Diseases diagnosis/ Peripheral Nerves physiopathology/ Reaction Time physiology/ Food Poisoning physiopathology/ Lathyrism physiopathology/ Legumes poisoning/ Neural Transmission physiology/ Peripheral Nerve Diseases physiopathology/ Neurology/ Lathyrus sativus/ Palestine/ Age/ Anterior horn/ Chickens Diagnosis/ Food poisoning/ Food/ H Reflex/ Lathyrism/ Lathyrism Aged/ Lathyrism electromyography/ Lathyrism motor neurons/ Lathyrus toxicity/ Motor neurons/ Muscles/ Nerves/ Neural/ Neurolathyrism/ Neurons/ Peripheral/ Physiology not plant/ Reflexes/ Spasticity/ Spastic paraparesis/ Toxicity L. sativus/ Toxicity/ Transmission.

Gopalan, C. (1992). **The contribution of nutrition research to the control of undernutrition: the Indian experience.** Annual Reviews of Nutrition **12**:1-17 (author affiliation: Nutrition Foundation of India, New Delhi)
Since diseases directly related to undernutrition are the major public health problems of India, nutrition research in the country has been largely directed towards elucidating their causes and identifying the most feasible methods for their prevention and control. This effort is an interdisciplinary exercise carried out in the laboratory, the clinic, and the field, with close interaction among biochemists, clinicians, and epidemiologists. Some of the identified solutions have found practical application; but, as in other areas of scientific endeavour, a gap exists between the acquisition of knowledge in the laboratories and its application in the field. Today, thanks to research efforts of the last few decades, we have the knowledge with which most diseases related to undernutrition can be prevented. Unfortunately, however, we do not always have the means of applying this knowledge under real-life conditions in the field. Even so, nutrition research during the last few decades has contributed significantly to the amelioration of undernutrition among poor communities in India.
Source: Medline 92368694
India/ Lathyrism prevention and control/ Nutrition Disorders aetiology/ Pellagra prevention and control/ Protein Energy Malnutrition prevention and control/ Vitamin A Deficiency prevention and control/ Nutrition review/ Nutrition Disorders prevention and control/ Review malnutriton Malnutrition review/ Famine/ Malnutrition/ Carotene/ Deficiency/ Delhi/ Energy/ India malnutrition/ India lathyrism/ Lathyrism/ Lathyrism India/ Lathyrism nutrition/ Lathyrism prevention/ Lathyrism review/ Nutrition/ Nutrition disorders/ Pellagra/ Prevention lathyrism/ Lathyrism prevention/ Protein/ Review/ Vitamin A/ Vitamins.

Khan, J. K.; Lambein, F., and Yusuf, H. K. (1992). **Beta-isoxazolinone-alanine and Lathyrism research - Optimisation of its isolation and purification.** Dhaka University Studies. Part E **7** (1):83-86
The biosynthetic precursor for the neurotoxin ODAP present in Lathyrus sativus (Khesari) is an unstable non-amino acid beta-(isoxazolin-5-on-2-yl) - alanine BIA. A scheme for it's purification was optimised. A three- step procedure leads to a pure crystalline compound.
Source: CGC_95_2 ; reprintDE
ODAP/ Lathyrus sativus/ Isoxazolin-5-one/ Beta Alanine analogs and derivatives/ Amino acids/ Isolation/ Khesari/ Neurotoxins/ Purification reprint.

Krogsgaard, L. P. and Hansen, J. J. (1992). **Naturally occurring excitatory amino acids as neurotoxins and leads in drug design.** Toxicology Letters (Amsterdam) **64-65 sec No**:409-416 (author affiliation: Department of Organic Chemistry, Royal Danish School of Pharmacy, Copenhagen)
The central excitatory neurotransmitter (S)-glutamic acid (Glu) activates at least three types of receptors the NMDA, AMPA, and kainic acid (KAIN) receptors. These receptors mediate the neurotoxicity of a number of naturally-occurring Glu analogues. Thus, domoic acid, a KAIN receptor agonist, has probably been the cause of severe neurologic illness in people who consumed domoic acid poisoned food. beta-N-oxalylaminoalanine (beta-ODAP), an AMPA receptor agonist, has been associated with lathyrism, a spastic paraparesis caused by dietary intake of Lathyrus sativus. The neurotoxic Amanita muscaria constituent ibotenic acid, a nonselective NMDA receptor agonist, has been used as a lead structure for the development of the specific NMDA receptor agonist AMAA, AMPA, and a number of therapeutically interesting AMPA and KAIN receptor agonists.
Source: Medline 93110690, Reprinted with permisssion (1992) Elsevier Science Ireland Ltd.
Alzheimer's Disease etiology/ Drug Design/ Ibotenic Acid pharmacology/ Receptors Glutamate drug effects/ Receptors N Methyl D Aspartate drug effects/ Review/ Neurotoxicity review/ ODAP/ Chemistry/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids reviews/ AMPA receptors/ Aspartic acid/ Diet/ Dietary intake/ Domoic acid/ Drugs/ Excitatory amino acid/ Food/ Glutamates/ Heavy metals/ Ibotenic acid Dietary/ Intake/ Kainic acid/ Lathyrism etiology/ Lathyrism review/ Lathyrus toxicity/ Metals/ Neurotoxicity/ Neurotoxins/ NMDA/ Receptors Spasticity/ Spastic paraparesis/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Rasmussen, M. A.; Foster, J. G., and Allison, M. J. (1992). **Lathyrus sylvestris (flatpea) toxicity in sheep and ruminal metabolism of flatpea neurolathyrogens**. In: James, L. F.; Keeler, R. F.; Bailey, E. M.; Cheeke, P. R., and Hegarty, M. P. (Eds). **Poisonous plants. Proceedings of the Third International Symposium**, Ames: Iowa State University Press, pp. 377-381. (author affiliation: USDA-ARS, PO Box 70, Ames, IA 50010, USA).

Ruminal metabolism of neurolathyrogens may be an important factor in the adaptation of ruminants to the legume flatpea. Initial studies indicated that flatpea lathyrogens were rapidly released after consumption and that animals consuming this legume were at risk of intoxication. Further studies indicated that 17- and 38-day stepwise adaptation periods inadequately protected sheep from flatpea intoxication. Symptoms of intoxication when consumption approached 75% dietary flatpea included muscular tremors, incoordination, seizures and death. Only after prolonged consumption (<4 months) of a nonlethal diet consisting of 50% flatpea did sheep successfully adapt to 100% dietary flatpea which they consumed with no complications. The exchange of rumen contents between alfalfa [lucerne]-fed and flatpea-fed sheep resulted in the formerly tolerant, flatpea-fed animal developing symptoms of lathyrism within 48 h. In contrast, the formerly naive, alfalfa-fed animal subsisted on 100% flatpea for 15 days with no indication of lathyrism. This evidence suggests that adaptation to flatpea is due to alterations in rumen metabolism. The rate of 2,4-diaminobutyric acid (DABA) degradation in rumen contents obtained from both unadapted and adapted sheep ranged between 0.2-0.3 µmol ml/h. The similarity of these degradation rates suggests that although DABA is the predominant lathyrogen in flatpea, other lathyrogenic compounds may be of greater importance in the aetiology of flatpea intoxication and protective adaptation.
Source: Copyright CAB Abstracts (94-94.6) V894450
Leguminosae/ Nervous system diseases/ Rumen microorganisms/ Poisonous plants/ Lathyrus/ Lathyrus sylvestris/ Toxicity/ Sheep/ Ruminants Antinutritional factors/ Adaptation/ Lathyrus tingitanus/ DABA/ Agriculture/ Lathyrism symptoms/ Medicago sativa/ Degradation Detoxification/ Diet/ Dietary/ Lathyrism/ Lathyrism animals/ Lathyrism complications/ Lathyrogens/ Lathyrus sylvestris/ Lathyrus toxicity Medicago/ Metabolism/ Microorganisms/ Muscles/ Nervous system/ Neurology/ Risk/ Rumen/ Symptoms lathyrism/ Tolerance/ Toxicity L. sylvestris/ Toxin/ USA/ USDA.

Shen, L. M.; Orcutt, D. M., and Foster, J. G. (1992). **Influence of polyethylene glycol and aeration method during imbibition on germination and subsequent seedling growth of flatpea (Lathyrus sylvestris).** Seed Science and Technology **20** (3):349-357 (author affiliation: Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA)
L. sylvestris seeds imbibed in media containing polyethylene glycol 8000 (PEG) at concentrations of 0 (water), 25, 35 or 50% (w/v). Imbibition solutions were aerated continuously with ambient air, bubbled with pure oxygen for 3 min every 12 h or were not provided with supplemental oxygen. Seeds were imbibed for 0.5, 1.0, 1.5, 2.5 or 3 d. Germination percentages were determined for all treatments, and seedling vigour was determined for aeration treatments. In seeds imbibed in PEG-free media, germination was better when air was supplied during imbibition. However, seeds imbibed in PEG-free media aerated with oxygen exhibited symptoms of toxicity, and seedlings derived from this treatment exhibited the greatest reduction in shoot and root growth. PEG diminished the adverse effects of oxygen on germination. That 50% PEG was less effective in this respect suggested the contribution of an osmoticum effect that was confirmed by the reduced germination rate of seeds imbibed in air-aerated and non-aerated 25% PEG media. Root growth appeared to be the most sensitive response to oxygen and osmotic treatments of seeds. It was concluded that osmoconditioning was of little value as a mean of improving germination of L. sylvestris seeds and performance of seedlings.
Source: Copyright CAB Abstracts (94-94.6) G650736
Lathyrus sylvestris/ Seed germination/ Osmotic pretreatment/ Oxygen/ Aeration/ Germination/ Seed treatment/ Osmotic priming/ water relations Imbibition/ Seed/ Toxicity/ Seedling/ Plant physiology/ Lathyrism symptoms/ Lathyrism/ Lathyrus sylvestris/ Lathyrus toxicity/ Osmotic/ Polyethylene/ Pretreatment/ Roots/ Root growth/ Seedling germination/ Seedling growth/ Seedling vigour/ Shoots/ Symptoms lathyrism/ Toxicity L. sylvestris/ USA/ Virginia/ Water/ Weed.

Tylleskär, T.; Banea, M.; Bikangi, N.; Cooke, R. D.; Poulter, N. H., and Rosling, H. (1992). **Cassava cyanogens and konzo, an upper motorneuron disease found in Africa**. The Lancet **339**:208-11
Source: reprintDE
Cassava toxicity/ Neurodegenerative diseases Konzo/ Lathyrism/ HCN/ Detoxification Cassava/ Processing/ Bitter varieties Cassava/ Sulfur Thiocyanates/ Sweden/ Myelopathy/ Spastic paraparesis/ Africa/ Cyanides/ Detoxification/ Konzo/ Lathyrism chronic Cassava toxicity/ Manihot esculenta/ Cassava/ Motor neurons/ Neurodegenerative/ Neurology/ Neurons/ Spasticity/ Toxicity/ Varieties/ reprint.

Geda, A.; Briggs, C. J., and Venkataram, S. (1993). **Determination of the neurolathyrogen beta-N-oxalyl-L-alpha,beta-diaminopropionic acid using high performance liquid chromatography with fluorometric detection.** Journal of Chromatography **635** (2):338-341
Source: Agricola (92-94.6) IND 93027976
ODAP analysis/ Method/ Lathyrism/ Neurotoxins/ HPLC/ Lathyrus sativus/ Chromatography/ ODAP.

Hugon, J.; Ludolph, A. C.; Spencer, P. S.; Roldan, S. G., and Dumas, J. L. (1993). **Studies of the etiology and pathogenesis of motor neuron diseases .3. Magnetic cortical stimulation in patients with lathyrism.** Acta Neurologica Scandinavica **88** (6):412-416 (author affiliation: Hugon J Univ Limoges Fac Med Inst Neurol Trop 2 Rue Docteur Marcland F-87025 Limoges France)

Neurophysiological assessments of central motor pathways were conducted of 11 Spanish subjects with varying degrees of spastic paraparesis (lathyrism). The disease has been induced more than 40 years ago by subsistance on the neurotixic chick pea Lathyrus sativus. Patient evolution was carried out by magnetic cortical and electric spinal stimulations and recordings of the contralateral muscle responses. Central motor conduction times corresponding to lower limbs were clearly more prolonged in those severely affected patients with marked difficulty walking (Stages 4 and 3). Central conduction times corresponding to upper limbs were delayed in only 1 patient. Taken together with clinical and published neuropathological data, these findings suggest that established lathyrism is essentially a central motor system disorder primarily affecting corticospinal tracts regulating the lower limbs. [References: 26].
Source: Copyright Current Contents
Lathyrism/ Spastic paraplegia/ Motor evoked potentials/ Clinical neurophysiology/ Human-brain/ Responses/ Sclerosis/ Cortex.

Hugon, J.; Ludolph, A. C.; Spencer, P. S.; Roldan, S. G., and Dumas, J. L. (1993). **Studies on the etiology and pathogenesis of motor neuron diseases. III. Magnetic cortical stimulation in patients with lathyrism.** Acta Neurologica Scandinavica **88** (6):412-416 (author affiliation: Hugon J Univ Limoges Fac Med Inst Neurol Trop 2 Rue Docteur Marcland F-87025 Limoges France; Limoges Univ Hosp Dept Neurol Limoges France; Humboldt Univ Berlin Charite Hosp Dept Neurol O-1086 Berlin Germany; Oregon Hlth Sci Univ Ctr Res Occupat & Environm Toxicol Dept Neurol Portland, Or 97201 USA; Hosp Gen Gregorio Maranon Madrid Spain)
Neurophysiological assessments of central motor pathways were conducted of 11 Spanish subjects with varying degrees of spastic paraparesis (lathyrism). The disease has been induced more than 40 years ago by subsistance on the neurotixic chick pea Lathyrus sativus. Patient evolution was carried out by magnetic cortical and electric spinal stimulations and recordings of the contralateral muscle responses. Central motor conduction times corresponding to lower limbs were clearly more prolonged in those severely affected patients with marked difficulty walking (Stages 4 and 3). Central conduction times corresponding to upper limbs were delayed in only 1 patient. Taken together with clinical and published neuropathological data, these findings suggest that established lathyrism is essentially a central motor system disorder primarily affecting corticospinal tracts regulating the lower limbs. [References: 26].
Source: Reprinted with permission Copyright 1993 Munksgaard Publishers, Copenhagen
Lathyrism Spain/ Spain lathyrism/ Spastic Paraplegia/ Motor Evoked Potentials/ Clinical Neurophysiology/ Neurology/ Lathyrus sativus Chickens/ Evolution/ France/ Germany/ Lathyrism/ Lathyrism etiology/ Lathyrism motor neurons/ Motor neurons/ Muscles/ Neurons/ Oregon Paraplegia/ Spain/ Spain L. sativus/ Spasticity/ Spastic paraparesis/ Spinal cord/ USA.

Jahan, K. and Ahmad, K. (1993). **Studies on neurolathyrism.** Environmental Research **60** (2):259-266 (author affiliation: Institute of Nutrition and Food Science, University of Dhaka, Bangladesh)
Neurolathyrism is a neurological condition seen among people who eat the seeds of Lathyrus sativus (LS) as a principal source of food energy for 2 months or more. It is characterised by severe muscular rigidity and paralysis of the lower limbs. beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid is the principal toxin found in the seed. No experimental animal model for neurolathyrism could be produced by feeding either the seeds or the toxin, although the condition has been known for centuries. We discovered that experimental neurolathyrism could be produced in guinea pigs and primates that needed an external supply of ascorbic acid by making them subclinically deficient in ascorbic acid and feeding them the seeds of LS or extracts thereof. Autoclaving the seeds of LS with lime removes the toxin.
Source: Medline 93231097; Reprinted with permission Copyright 1993 Academic Press
Ascorbic acid metabolism/ Ascorbic acid Deficiency complications/ Ascorbic acid Deficiency metabolism/ Disease Models Animal/ Food Contamination/ Guinea Pigs/ Haplorhini/ Lathyrism chemically induced/ Lathyrism complications/ Lathyrism metabolism/ Legumes adverse effects/ Muscular Diseases chemically induced/ Lathyrism/ Neurology/ Lathyrus sativus/ Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Ascorbic acid/ Vitamin C/ Bangladesh/ Contamination/ Deficiency/ Energy/ Environment/ Extraction/ Feeding/ Food/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bangladesh/ Lathyrism Bioassay/ Lathyrism nutrition/ Lathyrism vitamin C/ Lime/ Primates Metabolism/ Models/ Muscles/ Neurolathyrism/ Nutrition animal/ Nutrition/ Paralysis/ Rodents/ Seed/ Toxin/ Vitamins.

Khan, J. K.; Kuo, Y.-H.; Haque, R.; Lambein, F., and Haque, A. (1993). **Review on the role of excitatory amino acids in neurological disorders with emphasis on neurolathyrism: a hypothesis for the susceptibility for neurolathyrism**. Bangladesh Journal of Neuroscience **9** (1):24-33.
Activation of glutamate receptors by excitatory amino acids is believed to play a role in the pathogenesis of neurologic diseases. The concentration of amino acids in cerebrospinal fluid differs between neurolathyrism patients and controls. The concentration of the inhibitory neurotransmitter, glycine, shows a clear correlation with the duration of the disease, which resembles sporadic upper motor neurone diseases. Glutamate, zinc and glycine affect activity at the N-methyl-D-aspartate (NMDA) class of glutamate receptor. Zinc in mossy fibre axon is dynamically linked to neural signalling processes. It is proposed that _-ODAP, being a strong

zinc-chelator, can make metal ion complexes within CNS that may lead to the expression of toxicity. A role for zinc deficiency in the susceptibility for neurolathyrism is postulated.
Source: reprintDE
Lathyrus sativus toxicity/ NPAA/ ODAP/ Lathyrism zinc/ Zinc lathyrism/ Zinc/ Metals/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids reviews/ Aspartic acid/ Axons/ Bangladesh/ Central Nervous system/ Cerebrospinal fluid/ Deficiency/ Excitatory amino acid/ Fibre Glutamates/ Glutamates receptors/ Glycine/ Heavy metals/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism cerebrospinal fluid/ Lathyrism review Lathyrus sativus zinc/ Lathyrus toxicity/ Motor neurons/ Nervous system/ Neural/ Neurolathyrism/ Neurons/ NMDA/ NPAA review/ ODAP Zinc/ Receptors/ Review/ Susceptibility/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Trace elements/ Zinc deficiency/ reprint.

Kothari, S. L. (Ed) (1993). **Eat Kesari Dal (Lathyrus sativus) for better health at low cost**. Nagpur, M. S.: Academy of Nutrition Improvement.
Advocates that Lathyrus sativus is safe to eat and ignores malnutrition and poverty as being causally linked to lathyrism.
Source: reprintDE
Pamphleteering L. sativus/ India L. sativus consumption/ Lathyrus sativus India/ Human consumption L. sativus India/ Famine/ Malnutrition Poverty/ Economics/ Lathyrus sativus/ Dhal/ Human consumption/ India/ India L. sativus/ India malnutrition/ India lathyrism/ Khesari Lathyrism/ Lathyrism economics/ Lathyrism India/ Lathyrism nutrition/ Humans/ Nutrition/ reprint.

Kumari, V.; Mehera, R. B.; Baju, D. B., and Hima Bindu, K. (1993). **Genetic basis of flower colour production in grass pea**. Lathyrus and Lathyrism Newsletter **5**:10
Source: reprintDE
Flower colour genetics L. sativus/ Lathyrus sativus flower colour genetics/ Genetics flower colour L. sativus/ Breeding/ Genetics/ Lathyrus sativus/ Colour/ Flower colour/ Flower colour genetics/ Flowers/ Genetics flower colour/ reprint.

Miller, S.; Nunn, P. B., and Bridges, R. J. (1993). **Induction of astrocyte glutamine synthetase activity by the Lathyrus toxin beta N oxalyl L alpha,beta diaminopropionic acid (beta L ODAP).** Glia **7** (4):329-336 (author affiliation: Department of Psychobiology, University of California, Irvine 92717)
beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid (beta-L-ODAP) is thought to be the causative agent in lathyrism due to its neuroexcitatory and neurotoxic properties. We have recently reported that beta-L-ODAP is also gliotoxic at high concentrations (Bridges et al.: Brain Res 561:262, 1991). Evidence is now presented that low, subgliotoxic concentrations of beta-L-ODAP may alter the ability of astrocytes to regulate glutamate concentrations in the CNS by increasing astrocyte glutamine synthetase activity. When astrocytes cultured from rat cortex were exposed to 100 microM beta-L-ODAP for 24 h, the resulting glutamine synthetase activity was 155% of control levels. This effect was enantiomer- and isomer-specific, dose-dependent, and required protein translation as the induction was blocked with cycloheximide. The effect of beta-L-ODAP on glutamine synthetase was not mimicked by alpha-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA) or kainate, suggesting that the induction was not transduced solely through activation of cell surface non-N-methyl-D-aspartate (NMDA) glutamate receptors. An intracellular site of action of beta-L-ODAP is proposed because its effect on glutamine synthetase activity could be blocked by the amino acid uptake blocker dihydrokainate.
Source: Medline 93307820
Animals Newborn/ Astrocytes cytology/ Astrocytes drug effects/ Cell Death drug effects/ Cells Cultured/ Cerebral Cortex cytology/ Cerebral Cortex enzymology/ Cycloheximide pharmacology/ Dactinomycin pharmacology/ Dose Response Relationship Drug/ Enzyme Induction Glutamine Synthetase metabolism/ Ibotenic Acid analogs and derivatives/ Ibotenic Acid pharmacology/ Kainic Acid pharmacology/ Lactate Dehydrogenase analysis/ N Methylaspartate pharmacology/ Rats/ Rats Sprague Dawley/ Structure Activity Relationship/ Amino acids Diamino pharmacology/ Astrocytes enzymology/ Glutamine Synthetase biosynthesis/ Neurotoxins pharmacology/ Rodents/ ODAP/ Neurology/ Amino acids/ AMPA receptors/ Aspartic acid/ Astrocytes/ Biosynthesis/ Brain/ California/ Central Nervous system/ Cerebral Cortex/ Cycloheximide Cytology/ Drugs/ Enzymes/ Glutamates/ Glutamine/ Glutamates receptors/ Ibotenic acid/ Intracellular/ Isomerism ODAP/ Isomerism/ Kainic acid/ Lactate/ Lathyrism/ Lathyrism animals/ Lathyrism enzymology/ Lathyrism rats/ Metabolism plant/ Nervous system/ Neuroexcitatory Neurotoxins/ NMDA/ ODAP biosynthesis/ ODAP isomerism/ Protein/ Receptors/ Toxin/ Toxin biosynthesis.

Misra, U. K.; Sharma, V. P., and Singh, V. P. (1993). **Clinical aspects of neurolathyrism in Unnao, India.** Paraplegia **31** (4):249-254 (author affiliation: Department of Neurology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India)
To study the clinical picture of lathyrism in Unnao, India and compare it with that reported from other endemic areas, 41 patients from Unnao were studied. Their mean age was 42.9 years (range 22-85) and the mean duration of the illness was 17.1 years (range 2-30). They had been regularly consuming Lathyrus sativus (LS). The patients complained of walking difficulty due to weakness and leg stiffness (32 each), and of frequency of micturition (4). Gait abnormalities included spastic gait (24), toe walking (18) and the necessary use of walking sticks (13). Weakness was mild to moderate, and was less prominent than was spasticity. In 8 patients the physical signs were asymmetrical. Peripheral neuropathy was present in only one patient, but muscle atrophy and widespread fasciculations were not found. A higher frequency of peripheral neuropathy and lower motor neuron involvement has been reported from Bangladesh and Israel. Severe spasticity in the

absence of prominent weakness in lathyrism may be due to the involvement of certain specific groups of corticospinal fibres.
Source: Medline 93261714; Reprinted with permission. Copyright (1993) Stockton Press
Adult/ Aged/ Aged 80 and over/ Diet/ Gait/ India/ Lathyrism therapy/ Middle Age/ Muscle Spasticity physiopathology/ Lathyrism physiopathology/ Neurology/ Lathyrus sativus/ Palestine/ Age/ Bangladesh/ Endemic/ Fibre/ India Dietary/ Dietary/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism Aged/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism motor neurons/ Motor neurons/ Muscles/ Muscle spasticity/ Neurolathyrism/ Neurons/ Paraplegia/ Peripheral/ Physical/ Spasticity.

Pai, K. S. and Ravindranath, V. (1993). **L-BOAA induces selective inhibition of brain mitochondrial enzyme NADH-dehydrogenase.** Brain Research **621** (2):215-221 (author affiliation: Ravindranath V Natl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka IndiaNatl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka India)
Lathyrism, a human neurological disorder has been linked to the excessive consumption of a plant toxin, beta-oxalylamino-L-alanine L-B present in Lathyrus sativus. The present study was carried out to elucidate the biochemical mechanisms underlying L-BOAA-induced toxic insult. Incubation of sagittal slices of mouse brain with L-BOAA resulted in dose and time-dependent inhibition of mitochondrial NADH-dehydrogenase (NADH-DH). Significant inhibition of NADH-DH was seen following incubation of brain slices with very low concentration of L-BOAA (0.1 pM). L-BOAA also induced lactate dehydrogenase (LDH) leakage from the slice into the medium in dose-dependent manner. The inhibition of NADH-DH preceded LDH leakage from the slices into the medium. L-BOAA had no effect on other mitochondrial enzymes, namely, isocitrate dehydrogenase or cytochrome c oxidase. Incubation of isolated mouse brain mitochondria with L-BOAA also resulted in inhibition of NADH-DH. L-BOAA-induced inhibition of NADH-DH was prevented by non-N-methyl-D-aspartate (non-NMDA) glutamate receptor antagonists in general and alpha-amino-3-hydroxy-5-methylisoxazole-4-propionate (AMPA) receptor antagonist (NBQX) in particular. Other glutamate agonists examined namely, N-methyl-D-aspartate, beta-N-methylamino-L-alanine (L-BMAA), L-glutamic acid, N-acetylaspartylglutamate (NAAG), quisqualic acid, kainic acid or AMPA did not have any effect on NADH-DH activity in slices although they induced LDH leakage from the slice into the medium. Incubation of brain slices with L-BOAA did not induce lipid peroxidation or changes in glutathione levels. Prior incubation of slices with glutathione (GSH) or GSH-isopropyl ester did not prevent L-BOAA-induced inhibition of NADH-DH. However, incubation of isolated mitochondria with L-BOAA in the presence of GSH-isopropyl ester prevented L-BOAA-induced inhibition of NADH-DH, indicating the protective effect of mitochondrial glutathione in the prevention of L-BOAA-induced toxicity. [References: 41].
Source: ref ex Roy (pers. comm.); Reprinted with permission Copyright 1993 Elsevier Science B.V., Amsterdam, Netherlands
Quinoxalinediones/ Glutamates Receptor/ ODAP toxicity/ ODAP brain NADH-dehydrogenase/ NADH-dehydrogenase ODAP/ Lathyrus sativus toxicity/ Toxicity mechanism ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ AMPA receptors/ Aspartic acid/ Brain/ Enzymes/ Excitatory amino acid/ Glutamates/ Glutamates receptors/ Glutathione/ India/ India L. sativus/ India L. sativus consumption/ India lathyrism/ Isocitrate dehydrogenase/ Kainic acid/ Lactate dehydrogenase/ Lactate/ Lathyrism/ Lathyrism India/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism prevention/ Lathyrus toxicity/ Lipids/ Humans/ Mechanisms toxicity/ Mental/ Mice/ Mitochondria/ NADH/ NBQX/ NMDA/ ODAP/ Prevention lathyrism Lathyrism prevention/ Receptors/ Rodents/ Sulfur amino acids/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity Toxin.

Pai, K. S.; Shankar, S. K., and Ravindranath, V. (1993). **Billionfold difference in the toxic properties of the two excitatory amino acids, L-BOAA and L-BMAA: biochemical and morphological studies using mouse brain slices.** Neuroscience Research **17** (3):241-248 (author affiliation: Ravindranath V Natl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka India)
Plant amino acids beta-N-oxalylamino-L-alanine (L-BOAA, present in Lathyrus sativus) and beta-N-methylamino-L-alanine (L-BMAA, present in Cycas circinalis) have been implicated in the pathogenesis of human neurological disorders lathyrism and amyotrophic lateral sclerosis-Parkinson's dementia complex of Guam (ALS-PD), respectively. In view of the conflicting reports that have emerged on the role of L-BMAA in ALS-PD, we reinvestigated the comparative toxicity of L-BMAA and L-BOAA. We report here the potent toxicity of L-BOAA as examined in an in vitro model consisting of sagittal slices of mouse brain. Incubation of sagittal slices of mouse brain with L-BOAA (1 pM) resulted in significant leakage of lactate dehydrogenase (LDH) and potassium from the slices into the medium. Under similar conditions, L-BMAA-induced LDH leakage from the slices into the medium was observed only at very high concentration of the toxin, namely 1 mM. N-Methyl-D-aspartate (NMDA) receptor antagonists ameliorated the toxic effects of L-BMAA, while non-NMDA receptor antagonists (quinoxalinediones) protected against the toxicity of L-BOAA. Incubation of slices with L-BOAA for 1 h resulted in extensive vacuolation and degeneration of neurons in the thalamus and brain stem, and to a lesser extent in the hippocampus and cerebellar nuclei. The large sized neurons appeared to be affected to a greater extent than the smaller ones. The neurons in other

areas of the brain also revealed variable degree of degeneration with swelling of axons and dendrites. Thus, the present study demonstrates the potent toxicity of L-BOAA and elucidates for the first time, the billion-fold difference in the concentration of L-BOAA and L-BMAA required to elicit similar toxic response in vitro, using mouse brain slices. The study also demonstrates the selective vulnerability of certain regions of the brain to toxic insult by L-BOAA. [References: 19].
Source: ref ex Roy (pers. comm.)
Neurotoxicity/ Excitatory Amino Acid/ Quinoxalinediones/ NMDA receptor/ Glutamates Receptor/ ODAP toxicity/ Beta N-methylamino-L-alanine toxicity/ Toxicity ODAP/ NPAA toxicity/ Brain slice bioassay/ Bioassay brain slice/ Rodents bioassay/ Bioassay rodent/ Neurology/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Bioassay L. sativus Lathyrus sativus bioassay/ Axons/ Amino acids/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Cycas/ Dendrites/ Glutamates/ Glutamates receptors/ Guam/ Hippocampus/ In vitro/ India/ India L. sativus/ India lathyrism/ Lactate dehydrogenase/ Lactate/ Lathyrism/ Lathyrism Bioassay/ Lathyrism hippocampus/ Lathyrism India/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Humans/ Mental/ Mice/ Models/ Neurons NMDA/ NPAA/ Nuclei/ ODAP/ Potassium/ Receptors/ Reports/ Rodents/ Toxicity L. sativus/ Toxicity rodents bioassay/ Toxicity/ Toxin.

Rasmussen, M. A.; Allison, M. J., and Foster, J. G. (1993). **Flatpea intoxication in sheep and indications of ruminal adaptation.** Veterinary and Human Toxicology **35** (2):123-127
In a series of experiments lambs were adapted to feeding with pellets containing seed-bearing flatpea (Lathyrus sylvestris L.) by increasing flatpea content from 50% to 100% in steps of 10% for periods of 7 days at each level. The rumen contents of some adapted lambs were exchanged with the rumen contents of lambs fed alfalfa. All exchanged lambs were fed flatpea in hay at 2200 g/day. In a third experiment lambs adapted to flatpea at 60% for 7 days were fed 100% flatpea for 62 days. These lambs were then fed monensin (30 mg/kg daily). Signs of intoxication included seizure, muscular trembling and spasmotic torticollis, and were similar to those seen in ammonia toxicosis in ruminants. Accumulation of ammonia may be a direct consequence of flatpea ingestion since 2,4-diaminobutyric acid (DABA), a toxic constituent, is known to inhibit hepatic urea synthesis. Other modes of toxicity for DABA and other flatpea toxins may contribute to this process of intoxication. The results suggest that ruminal microbes are responsible for flatpea detoxification and protection. The adaptation of sheep to flatpea may be due to increased ruminal detoxification. Ruminal protective functions can be disrupted through abrupt monensin feeding or the replacement of non-adapted for adapted rumen contents. This disruption temporarily suppresses mechanisms of ruminal detoxification and the sheep can reacquire vulnerability to flatpea intoxification.
Source: Agricola (92-94.6) IND 20380600, Reprinted with permission Copyright (1993) American College of Veterinary Toxicologists
Animal experiments/ Poisoning/ Rumen microorganisms/ Monensin/ Lathyrus/ Sheep/ Poisonous plants/ Lathyrus sylvestris/ Toxicity Detoxification/ Ruminants/ Antinutritional factors/ Adaptation/ DABA/ Hay/ Agriculture/ Lathyrism symptoms/ Medicago sativa/ Ammonia Feeding/ Feed ruminants/ Feed Lathyrus ochrus/ Feed Lathyrus sylvestris/ Lambs/ Lathyrism/ Lathyrism animals/ Lathyrism mechanisms Lathyrism veterinary/ Lathyrus ochrus/ Lathyrus sylvestris/ Lathyrus toxicity/ Liver/ Humans/ Mechanisms toxicity/ Medicago/ Microorganisms Muscles/ Rumen/ Ruminant feed/ Seed/ Sheep feed/ Symptoms lathyrism/ Toxicity L. sylvestris/ Toxin/ Urea.

Rowe, L. D.; Ivie, G. W.; DeLoach, J. R., and Foster, J. G. (1993). **The toxic effects of mature flatpea (Lathyrus sylvestris L cv Lathco) on sheep.** Veterinary and Human Toxicology **35** (2):127-133 (author affiliation: Food Animal Protection Research Laboratory, USDA-ARS, Route 5, Box 810, College Station, TX 77845, USA)
Groups of 5 adult ewes, assigned by weight and reproductive status (barren or in last 10 weeks of pregnancy), were fed pelleted diets containing mature, seed-bearing flatpea at 0, 35.0, 52.5 or 70.0% for 42 days, or at increasing levels of 17.5, 35.0, 52.5 and 70.0% over 42 days. The dose-related responses to the diets included a fluctuating reduction in feed intake for diets containing 35% and above of flatpea, potentially fatal acute central nervous signs at levels as low as 35%, and reduced weight gains at levels of 52.5% and over. A wasting condition developed in one ewe fed at 52.5%. Four of 5 ewes and one lamb fed increasing levels developed acute signs of poisoning. One of these ewes developed acute neurotoxicosis when fed at the 52.5% level; 3 other ewes and one orphaned lamb (40 days old) developed neurotoxicosis at the 70.0% level. 18 lambs were born to 16 flatpea-fed ewes in this study; there was no evidence that flatpea feeding adversely affected late pregnancy, parturition, lactation or lamb health.
Source: Reprinted with permission Copyright (1993) American College of Veterinary Toxicologists
Animal experiments/ Wasting diseases/ Lathyrus spp sheep poisoning/ Poisonous plants sheep/ Lathyrus sylvestris toxicity/ Ewes/ Reproduction Intake/ Ruminants/ Agriculture/ Lathyrism symptoms/ Diet/ Dietary intake/ Feed/ Feeding/ Feed ruminants/ Feed intake/ Feed Lathyrus ochrus Feed Lathyrus sylvestris/ Food/ Dietary/ Lambs/ Lathyrism/ Lathyrism animals/ Lathyrism veterinary/ Lathyrus ochrus/ Lathyrus sylvestris Lathyrus spp/ Lathyrus toxicity/ Humans/ Poisonous plants/ Pregnancy/ Ruminant feed/ Seed/ Sheep/ Sheep feed/ Symptoms lathyrism/ Toxicity L. sylvestris/ Toxicity Lathyrus spp/ Toxicity/ USA/ USDA.

Spencer, P. S.; Ludolph, A. C., and Kisby, G. E. (1993). **Neurologic diseases associated with use of plant components with toxic potential.** Environmental Research **62** (1):106 (author affiliation: Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University, Portland 97201)

Epidemics of neurotoxic disease in developing regions of the world are often associated with dietary dependence on plant components with inherent toxic potential or which have spoiled and become contaminated with mycotoxins. Diseases triggered by plant toxins include lathyrism and cassavism, types of irreversible spastic parapareses associated with staple diets of grass pea and bitter cassava root, respectively. Mildewed sugarcane poisoning, an encephalopathy and tardive dystonia, illustrates the neurotoxic effects of a widely distributed plant and fungal toxin. Food and medicinal use of the neurotoxic cycad plant is thought to have a role in the etiology of western Pacific amyotrophic lateral sclerosis and parkinsonism-dementia. Plant-associated neurotoxicity is a significant and preventable cause of morbidity in certain regions of Africa, Asia, and Oceania.
Source: Medline 93314607; Reprinted with permission Copyright 1993 Academic Press
Plants Toxic chemistry/ Nervous system diseases chemically induced/ Plants Toxic/ Neurology/ Antinutritional factors/ Mycotoxins/ Africa Amyotrophic lateral sclerosis/ Asia/ Chemistry/ Diet/ Environment/ Food/ Fungi/ Mycology/ Dietary/ Lathyrism etiology/ Lathyrism mycotoxins/ Manihot esculenta/ Cassava/ Medicinal/ Microbiology/ Nervous system/ Neurotoxicity/ Neurotoxins/ Oregon/ Phytochemistry Prevention lathyrism/ Lathyrism prevention/ Roots/ Spasticity/ Toxin/ Nervous system diseases.

Tekle Haimanot, R.; Abegaz, B. M.; Wuhib, E.; Kassina, A.; Kidane, Y.; Kebede, N.; Alemu, T., and Spencer, P. S. (1993). **Pattern of Lathyrus sativus (grass pea) consumption and beta-N-oxalyl-alpha,beta-diaminopropionic acid (beta-ODAP) content of food samples in the lathyrism endemic region of Northwest Ethiopia.** Nutrition Research **13** (10):1113-1126 (author affiliation: Faculty of Medicine, Addis Ababa University, P.O.Box 4147, Addis Ababa)
Grass pea, a legume whose consumption is associated with human lathyrism, is an important food crop among the poorer sectors of society in many parts of Ethiopia. A nutritional survey, focussing on the preparation and consumption of grass pea, in 224 families of two villages of a lathyrism endemic area in northwestern Ethiopia has been undertaken. Grass pea is grown in only one of the two villages. Raw as well as cooked food samples were collected and the levels of beta-ODAP determined by the OPT-method. Grass pea foods were also prepared in the laboratory following methods used in the villages and analysed for their toxin level to derive information if certain procedures were capable of reducing the level of toxin. Steeping grass pea in excess water leaches out ca 30% of the beta-ODAP. Grass pea bread (kitta) and roasted seeds (kollo) showed elevated levels of beta-ODAP as compared to the seeds used in the preparation of these foods. Lower levels of beta-ODAP were found in boiled snacks (nifro) and the flour form (shiro).
Source: Lambein_95_5
Lathyrism Ethiopia/ Ethiopia lathyrism/ Ethiopia nutritional survey/ Lathyrus sativus food preparation/ ODAP L. sativus food/ Human consumption L. sativus/ Lathyrus sativus/ Agriculture/ Bread/ Endemic/ Ethiopia/ Flour/ Food L. sativus/ Food preparation/ Food/ Human consumption/ Lathyrism/ Lathyrism nutrition/ Humans/ Nutrition/ Nutrition surveys/ ODAP/ Seed/ Surveys/ Toxin/ Water.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kassina, A.; Endeshaw, Y.; Alemu, T., and Spencer, P. S. (1993). **The epidemiology of lathyrism in north and central Ethiopia.** Ethiopian Medical Journal **31** (1):15-24 (author affiliation: Faculty of Medicine, Addis Ababa University, Ethiopia)
Lathyrism is a neurotoxic disorder caused by excessive, prolonged consumption of the hardy, environmentally tolerant legume, the grass-pea, Lathyrus sativus, which contains the neurotoxic amino acid beta-N-oxalylamino-L-alanine acid (BOAA). The disease develops after heavy consumption of grass-pea for over two months. It is uniformly manifested by a predominantly motor spastic paraparesis with varying degrees of disability. A door-to-door epidemiological survey for the disease using trained lay health workers was carried out in the major areas of northwest and central Ethiopia where L. sativus is grown. For security reasons, some of the other endemic areas were not accessible for the survey. The survey involved a population of 1,011,272. A total of 3,026 affected persons were identified. The disease was found to be widespread in the northwest and central highland areas of the country. The prevalence rates ranged from 1/10,000 to 7.5/1,000. The highest prevalences were in North and South Gonder, and East and West Gojam. The male:female ratio of cases was 2.6:1; the females exhibited a milder form of the disease. The cultivation of L. sativus is increasing in Ethiopia, which makes the development of low-BOAA strains very important in order to control the high incidence of lathyrism, a crippling disease which affects the productive young members of the society.
Source: Medline 93170259 ; reprintDE, reprinted with permission Copyright 1993 Ethiopian Medical Journal
Adolescence/ Adult/ Child/ Child Preschool/ Diet Surveys/ Ethiopia epidemiology/ Incidence/ Lathyrism etiology/ Lathyrism prevention and control/ Population Surveillance/ Prevalence/ Rural Population/ Lathyrism epidemiology/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Cultivation/ Diet/ Endemic/ Epidemiology lathyrism/ Ethiopia/ Female/ Lathyrism/ Lathyrism Adolescence/ Lathyrism Ethiopia/ Lathyrism prevention/ Males/ Humans/ Neurotoxins/ Population/ Prevention lathyrism/ Lathyrism prevention Rural/ Spasticity/ Spastic paraparesis/ Strains/ Surveys/ Tolerance/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1993). **Neuronal damage induced by beta-N-oxalylamino-L-alanine, in the rat hippocampus, can be prevented by a non-NMDA antagonist, 2,3-dihydroxy-6-nitro-7-sulfamoyl-benzo(f)quinoxaline.** Brain Research **627** (1):55-62 (author

affiliation: Willis Cl Inst Psychiat Dept Neurol Denmark Hill London Se5 8af England; Inst Psychiat Dept Neurosci London Se5 8af England; Univ London Kings Coll Div Biomed Sci London Wc2r 2ls England)
The neurotoxin beta-N-oxalylamino-L-alanine (BOAA), found in Lathyrus sativus seeds, is thought to be the causative agent of neurolathyrism. We have investigated the in vivo mechanism of action of BOAA by focal injection (1 mul) in the dorsal hippocampus of male Wistar rats and comparing the pathological outcome with the effects of injections (1 mul) of a-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA), kainate (KA) or N-methyl-D-aspartate (NMDA). Cellular damage induced by the excitatory amino acids in the pyramidal (CA1-CA4) and dentate granule neurones (DG) was assessed histologically 24 h after the injection. The study shows that BOAA (50 nmol) induces hippocampal toxicity with a highly selective pattern of regional cellular damage. The CA1, CA4 and DG subfields show 70-90% neuronal injury whereas CA2 and CA3 show only minimal damage. This pattern of cellular damage is similar to that induced by AMPA (1 nmol) and NMDA (25 nmol) but not KA (0.5 nmol). BOAA-induced neurotoxicity is prevented in a dose-dependent manner by focal co-injection of the non-NMDA receptor antagonist 2,3-dihydroxy-6-nitro-7-sulfamoyl-benzo(F)quinoxaline (NBQX) (1-25 nmol) but not by a dose of MK-801 (3 mg/kg i.p.) which is neuroprotective against an injection of NMDA. Delayed focal injections of NBQX (25 nmol) up to 2 h after the BOAA injection result in a significant protection of all pyramidal and granular cell regions. These results indicate that the in vivo hippocampal toxicity of BOAA is mediated by AMPA receptors rather than by KA or NMDA receptors. Neurones in the rat hippocampus do not die immediately when exposed to BOAA but via a delayed process involving sustained AMPA receptor activation. Excitotoxic processes acting via AMPA receptors may play a role in the chronic loss of motor neurones seen in amyotrophic lateral sclerosis. [References: 39].
Source: Reprinted with permission Copyright 1993 Elsevier Science B.V., Amsterdam, Netherlands
ODAP/ NBQX/ Neurotoxicity/ Neurolathyrism/ Motor neuron disorder/ Excitatory amino acid/ ODAP toxicity prevention/ Lathyrism/ Bioassay rodent/ Rats/ KA receptors/ NMDA receptors/ Neurology/ Biochemistry/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives Bioassay L. sativus/ Lathyrus sativus bioassay/ Amino acids/ Amino acids toxicity/ AMPA receptors/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Denmark/ England/ Hippocampus/ Injections/ Kainic acid/ Lathyrism Bioassay/ Lathyrism Biochemistry/ Lathyrism hippocampus Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism prevention/ Lathyrism rats/ Lathyrus toxicity/ Males/ Mechanisms toxicity/ Motor neurons/ Neurons/ Neurotoxins/ NMDA/ Prevention lathyrism/ Lathyrism prevention/ Receptors/ Rodents/ Seed/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity mechanism ODAP/ Toxicity rodents bioassay/ Toxicity/ UK.

Abegaz, B. M.; Nunn, P. B.; De Bruyn, A., and Lambein, F. (1994). **Thermal isomerization of N-oxalyl derivatives of diamino acids**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 89-96.
Source: reprintDE
NPAA/ NPAA chemistry/ ODAP chemistry/ Chemistry/ Ethiopia/ Lathyrism Ethiopia/ ODAP/ ODAP isomerism/ Isomerism ODAP Temperature/ reprint.

Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (1994). (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation.
Source: reprintDE
Lathyrism/ Lathyrus sativus/ Ethiopia/ Lathyrism Ethiopia/ reprint.

Addis, G. and Narayan, R. K. J. (1994). **Quantitative variation in the amount of neurotoxin, beta-N-oxalyl-alpha,beta-diamino-propionic acid, in Lathyrus sativus during ontogeny**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 83-88.
Species of Lathyrus accumulate a variety of secondary metabolites in their seeds, many of which are potentially toxic to man and animals. beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP) assumes the greatest significance. It is a non-protein amino acid which causes both human and animal lathyrism. A study was conducted to assess variations in the amount of ODAP between Lathyrus species, between varieties of Lathyrus sativus and between tissues and organs in L. sativus during different developmental stages. High-voltage electrophoresis, thin-layer chromatography and chemical analysis were used during the investigation. Significant variations in the amount of ODAP between Lathyrus species and between varieties of L. sativus were observed. Results further established that during ontogeny, the biosynthesis and accumulation of ODAP was tissue specific and developmentally regulated. The reproductive organ tissues accumulated more ODAP than vegetative parts during development.
Source: reprintDE

Lathyrus sativus development/ ODAP biosynthesis/ Development L sativus ODAP/ Biosynthesis/ Lathyrus sativus/ Amino acids/ Chemical analysis/ Chromatography/ Electrophoresis/ Ethiopia/ Lathyrism animals/ Lathyrism Ethiopia/ Lathyrus toxicity/ Humans/ Neurotoxins/ ODAP Ontogeny/ Protein/ Reproduction/ Seed/ Tissue/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Varieties/ reprint.

Araya, W. A. (1994). **Adaptation of low neurotoxin lines of grass pea (L sativus) introduced from Canada and tested at Adet, Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 79-82.
Low neurotoxic lines of grass pea supplied by Dr. Campbell, Manitoba Research Station, Canada, were tested out at Adet Research Center, Ethiopia in 1991/92. The tests were carried out in a Cambisol soil type. The materials were planted on Oct. 3, 1991 in a single-rowed non-replicated nursery. Objectives were (i) to test, under Adet conditions, the adaptability of introduced low neurotoxin lines from Canada, and (ii) to identify genes or characters from low neurotoxin lines that could be incorporated into local genotypes. Data collected included days to flowering, days to maturity, powdery mildew (0-9 scale), height (cm), pods/plant, flower color, and growth habit. The yield was not measured because of conditions during the test period were beyond control; however, yield components were determined. The results showed that the local check had the highest number of pods/plant comparatively. NC8a-95 and NC8a-97/1 had the highest pods/plant of the low neurotoxin lines; NC8a-97/1 also had the highest number of seeds/pod (3 seeds/pod). None of the low neurotoxin lines were free of powdery mildew attack. Promising lines, which included NC8a-97/1, NC8a-157, NC8a-84, LS 8246, and NC8a-95, should be tested further in variety and verification trials to determine their performance or to incorporate the low neurotoxin character from the germplasm into promising local genotypes.
Source: reprintDE
Lathyrus sativus adaptation/ Adaptation L sativus Ethiopia/ Lathyrus sativus low ODAP/ Powdery mildew/ Phytopathology/ Adaptation/ Soil Lathyrus sativus/ Agriculture/ Genetic resources/ Canada/ Colour/ Erysiphe/ Ethiopia/ Evaluation genetic resources/ Flowering/ Flowers/ Fungi Mycology/ Genes/ Genotypes/ Habit/ Height/ Lathyrism Ethiopia/ Manitoba/ Maturity/ Microbiology/ Neurotoxins/ Pods/ Seed/ Soil microbiology/ Soil type/ Yield/ Yield components L. sativus/ Yield L. sativus/ Diseases plant/ reprint.

Araya, W. A. (1994). **An effort to improve grass pea (L sativus) in some parts of Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 73-78.
One of the solutions for the problem of lathyrism is the identification and utilisation of low-ODAP lines of grass pea. A a total of 20 grass pea varieties was tested at Adet Research Center, Ethiopia for a period of two years in 1989/90 and 1990/91. The test was done in a randomised complete block design with four replications. The data collected included number of days to flowering, maturity, height (cm), pods/plant, seeds pod, 1000 grain weight, grain yield, and ODAP content. There was no significant yield difference among the varieties in 1990/1991. When averaged over the two years, PGRCE 46066 was the highest yielding variety with a yield level of 3426 kg ha-1. The ODAP level of the varieties varied in different seasons; however, there were varieties where the variation was negligible. When averaged over the two years, PGRCE 201538 had a minimum ODAP level of 0.35%. PGRRCE 201513, one of the best yielding varieties of those tested, had the lowest ODAP levels. More elaborate studies on the relationship between ODAP content and environment interaction are required.
Source: reprintDE
Lathyrus sativus Ethiopia/ Ethiopia L sativus improvement/ ODAP/ Lathyrus sativus/ Environment/ Ethiopia/ Flowering/ Height/ Lathyrism Ethiopia/ Maturity/ Pods/ Seed/ Seed yield/ Utilisation/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Yield/ Yield L. sativus/ reprint.

Cohn, D. F. (1994). **Does neurolathyrism affect longevity?** In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 33-35.
Source: reprintDE
Lathyrism longevity/ Neurology/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ Longevity/ Neurolathyrism/ reprint.

Dibabe, A.; Araya, W. A.; Hundie, B.; Ensermu, R.; Haile, W.; Ashagrie, Y.; Yalew, A., and Seyoum, W. (1994). **The status of grass pea (Lathyrus sativus) research and production in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 45-60.
Grass pea (Lathyrus sativus) occupies 8.7 % of the total area and 7.6 % of the total production of food legumes in Ethiopia. It is produced in areas with adverse agricultural conditions. It performs well on heavy

black soils which promote waterlogging. Grass pea production is mainly concentrated in the northwest zone (58.0%), the central zone (16.3%), the north-east (12.8%), and the northern as well as the southeast region of Ethiopia (12.9). Like most crops in Ethiopia, grass pea grain is used for human consumption and the straw as animal feed. One of the ways to utilise the crop properly is through the identification of grass pea varieties with low ODAP toxin and reasonable yield. A total of 177 grass pea germplasm accessions has been identified and varieties with a ODAP content of 0.2-0.5 % advanced to the next stages. The seed yield data of the variety trials conducted in 1989 and 1991 revealed that the overall mean yields were 2856 kg/ha and 3297 kg/ ha, respectively. PGRC/E46060 gave the highest yield of 3385 kg/ha in 1989, whereas PGRC/E46066 gave the highest yield of 3661 kg/ha in 1991. There was no correlation between ODAP content and yield components. The major diseases that attack grass pea are rust and powdery mildew. The major insects are aphids, thrips and bollworm. Aphids are the most important pest. Most of the farmer's fields assessed were low in weed infestation. Weeds such as Hygrophylla auriculata, Guizotia scabra, Cynodon dactylon, Lactuca serriola, Pennisetum romosum and Daucus carota were found to be the major weeds of grass pea in the northwestern region of Ethiopia. A survey on the nodulation pattern of grass pea was done in the major grass pea-growing areas of the northwest. Most of the nodules in the samples collected were not effective in fixing nitrogen from the atmosphere.

Source: reprintDE

Lathyrus sativus research Ethiopia/ Ethiopia L. sativus research/ ODAP/ Agronomy/ Farming systems/ Waterlogging/ Phytopathology/ Soil Lathyrus sativus/ Entomology/ Straw/ Agriculture/ Genetic resources/ Animal feed/ Aphids/ Erysiphe/ Ethiopia/ Feed/ Feed Lathyrus sativus Flooding/ Food/ Fungi/ Mycology/ Guizotia/ Human consumption/ Insects/ Lathyrism/ Lathyrism animals/ Lathyrism Ethiopia/ Lathyrus sativus agronomy/ Humans/ Microbiology/ Nitrogen/ Nodulation/ Pests/ Powdery mildew/ Rust/ Seed/ Seed yield/ Soil microbiology/ Surveys/ Toxin Varieties/ Variety trials/ Varieties L. odoratus/ Varieties L. sativus/ Lathyrus sativus varieties/ Lathyrus odoratus varieties/ Water/ Weed/ Yield Yield components L. sativus/ Yield L. sativus/ Diseases plant/ reprint.

Gimenez-Roldan, S.; Ludolph, A. C.; Hugon, J.; Hens, M.; Mateo, D.; Kisby, G. E., and Spencer, P. S. (1994). **Lathyrism in Spain: Progressive central nervous system deficits more than 45 years after onset**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 10-25.

During the famine following the Spanish Civil war (1936-1939), outbreaks of human lathyrism occurred in the Spanish provinces of Catalonia and Castillia because of heavy consumption of food containing Lathyrus spp. seed, a neurotoxic legume. In June 1988, we studied 14 male subjects, aged 49-70 years, who developed lathyrism during childhood or adolescence, for evidence of recent clinical deterioration. Each patient displayed a characteristic pattern of neurological deficit, and 10 complained of deterioration of motor performance (increased leg stiffness, shortening of steps and a tendency to scrape the floor with toes) which had developed over the previous 2-10 years. This was reportedly accompanied by the appearance, or by an increase of severity and frequency, of painful nocturnal calf-muscle cramping. Five of the 10 no longer consumed Lathyrus, while 3 or 4 with seemingly static illness reported continued occasional intake. However, 8 of 9 patients showed measurable levels of the Lathyrus neurotoxin, alpha-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP). Age, disease duration, clinical severity at onset, and continued consumption of Lathyrus spp., could not be associated with susceptibility to deterioration. Finally, the clinical presentation and pattern of neurological deficit in Spanish peasants with lathyrism closely resembles that of Bangladesh, Ethiopian, Indian, and Israeli patients, but was clearly different from the rapidly progressive disease seen in sporadic amyotrophic lateral sclerosis.

Source: reprintDE

Lathyrism Spain/ Spain lathyrism/ Ruminants/ ODAP/ Neurology/ Famine/ Malnutrition/ Cattle/ Agriculture/ Age/ Amyotrophic lateral sclerosis/ Bangladesh/ Calves/ Central Nervous system/ Ethiopia/ Food/ India/ India malnutrition/ India lathyrism/ Intake/ Lathyrism/ Lathyrism Adolescence/ Lathyrism Aged/ Lathyrism Bangladesh/ Lathyrism Ethiopia/ Lathyrism India/ Lathyrus spp/ Males/ Humans/ Muscles/ Nervous system/ Neurotoxins/ Poultry/ Seed/ Spain/ Susceptibility/ reprint.

Haque, A.; Hossain, M.; Khan, J. K.; Kuo, Y.-H., and Lambein, F. (1994). **New findings and symptomatic treatment for neurolathyrism, a motor neuron disease occurring in North West Bangladesh**. Paraplegia **32**:193-195.

Neurolathyrism is a form of spastic paraparesis caused by the neuroexcitatory amino acid 3-N-oxalyl-L-2,3-diaminopropanoic acid (_-ODAP) present in the seeds and foliage of Lathyrus sativus. Tolperisone HCl, a centrally acting muscle relaxant, has been shown to reduce significantly the spasticity in neurolathyrism patients. Sporadic occurrence of HTLV-1 infection (0.9%) and of osteolathyrism was found among the neurolathyrism patients. Osteolathyrism is linked to the consumption of the green shoots of Lathyrus sativus.

Source: reprintDE; reprinted with permission. Copyright (1994) Stockton Press

Lathyrism viral infection/ HTLV-1 lathyrism/ Tolperisone lathyrism treatment/ Symptomatic treatment lathyrism/ Muscle relaxant lathyrism treatment/ Lathyrism treatment/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Osteolathyrism Bangladesh/ Bangladesh ODAP/ Neurology Lathyrus sativus/ Osteolathyrism/ Amino acids/ Bangladesh/ HTLV/ Infection/ Lathyrism/ Lathyrism motor neurons/ Lathyrism treatment Motor neurons/ Muscles/ Neuroexcitatory/ Neurolathyrism/ Neurons/ ODAP/ Paraplegia/ Seed/ Shoots/ Spasticity/ Spastic paraparesis/ reprint.

Lambein, F.; Haque, R.; Khan, J. K.; Kebede, N., and Kuo, Y.-H. (1994). **From soil to brain: Zinc deficiency increases the neurotoxicity of Lathyrus sativus and may affect the susceptibility for the motorneurone disease neurolathyrism.** Toxicon **32** (4):461-466 (author affiliation: Laboratory of Physiological Chemistry, Faculty of Medicine, University of Ghent, Ledeganckstraat 35, B-9000 Gent, Belgium)

Zinc deficiency and oversupply of iron to the roots of grass pea (Lathyrus sativus) induce increases in the content of the neurotoxin beta-L-ODAP (3-oxalyl-L-2,3-diaminopropanoic acid) in the ripe seeds. The transport of zinc to the shoots is enhanced by the addition of beta-L-ODAP. The neurotoxin of Lathyrus sativus is proposed to function as a carrier molecule for zinc ions. Soils, depleted in micronutrients from flooding by monsoon rains (Indian subcontinent) or otherwise poor in available zinc and with high iron content (Ethiopian vertisols), may be responsible for higher incidence of human lathyrism, one of the oldest neurotoxic diseases known to man. A role for brain zinc deficiency in the susceptibility for lathyrism is postulated.

Source: reprintDE

Lathyrus sativus Zinc/ Zinc deficiency/ Nutrient manipulation Zinc/ Lathyrism susceptibility/ ODAP Zinc/ Soil Zinc/ Brain Zinc/ Neurology Lathyrism zinc/ Zinc lathyrism/ Zinc/ Waterlogging/ Soil/ Lathyrus sativus/ Brain/ Chemistry/ Deficiency/ Ethiopia/ Flooding/ Belgium/ Heavy metals/ Incidence/ India/ India L. sativus/ India lathyrism/ Iron/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism India/ Humans/ Metals/ Motor neurons/ Neurolathyrism/ Neurons/ Neurotoxicity/ Neurotoxins/ Nutrients/ ODAP/ Roots/ Seed/ Shoots/ Susceptibility/ Trace elements Vertisols/ Soil vertisol/ Water/ reprint.

Lambein, F.; Wouters, G.; Haque, A.; Hussain, M., and Yusul, H. K. M. (1994). **Recent progress in the Bangladesh-Belgium Inter-University Project**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 127-139.

Source: reprintDE

INILSEL/ Lathyrus sativus research Belgium/ Lathyrus sativus research Bangladesh/ Lathyrus sativus/ Bangladesh/ Ethiopia/ Belgium Lathyrism Bangladesh/ Lathyrism Ethiopia/ reprint.

Miller, S. E. (1994) **Aspects of glutamatergic function in astrocytes: glutamine synthetase regulation and metabotropic glutamate receptors** [PhD thesis]: University of California, Irvine, 157 pp.

The traditional view that astrocytes are passive support cells has begun to give way to a new consensus that these cells have dynamic roles in development, in the response to injury and disease, and in chemical and electrical signalling. In this context, this dissertation examines two aspects of astrocyte glutamatergic function using cultured cortical astrocytes as the model system. First, the effects were examined of exogenously applied excitatory amino acids on glutamine synthetase (GS), a key enzyme in glutamate metabolism. Two excitatory amino acids were identified which induced GS activity: $/beta$-N-Oxalyl-L-$/alpha,/beta$-diaminopropionic acid ($/beta$-L-ODAP), the putative Lathyrus toxin, and the metabotropic glutamate receptor (mGluR) agonist 1-aminocyclopentane-trans-1,3-dicarboxylic acid (trans-ACPD). The abilities of these compounds to induce GS activity were concentration-dependent, stereoselective, and could be reduced by the protein translation inhibitor cycloheximide. The possible significance of these alterations in GS activity for the regulation of glutamate homeostasis is discussed. The ability of the mGluR agonist trans-ACPD to increase GS activity suggested that mGluRs might have important roles in astrocyte function and led to the second series of studies which examined mGluR signal transduction and its regulation in astrocytes. The presence of two metabotropic signal transduction pathways for glutamate was demonstrated: stimulation of phosphoinositide hydrolysis and inhibition of cyclic AMP accumulation. The antagonist $ alpha$-methyl-4-carboxyphenylglycine was shown to block stimulation of phosphoinositide hydrolysis but not inhibition of cyclic AMP accumulation, providing a means to pharmacologically dissociate these two pathways. The glutamate transport inhibitor, L-trans-2,4-pyrrolidine dicarboxylic acid, was shown to also be an mGluR agonist in astrocytes and was particularly effective at reducing cyclic AMP accumulation. The phosphoinositide pathway was modifiable according to the chemical conditions of the culture environment. When astrocytes were cultured in a serum-free defined medium, trans-ACPD produced much larger stimulations of phosphoinositide hydrolysis than had been estimated in previous studies using conventional culture techniques. This increased stimulation appeared to be selective for mGluR agonists and was accompanied by a large increase in the expression of the mGluR5 subtype, as determined by Western immunoblotting. Further studies in serum-free culture revealed that both trans-ACPD-stimulated

phosphoinositide hydrolysis and mGluR5 expression could be increased by previous exposure of the astrocytes to basic fibroblast growth factor, epidermal growth factor, or transforming growth factor-$/alpha$.
Lathyrism/ ODAP toxicity mechanism/ Glutamates receptors/ Glutamine synthetase regulation/ Biochemistry/ Neurology/ Nerve cells Astrocytes/ Amino acids/ California/ cAMP/ Cycloheximide/ Dissertations/ Distribution plants/ Environment/ Enzymes/ Epidermis/ Excitatory amino acid/ Glutamates/ Glutamine/ Hydrolysis/ Lathyrism Biochemistry/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism serum Lathyrus toxicity/ Mechanisms toxicity/ Metabolism plant/ Models/ Nerves/ ODAP/ Protein/ Receptors/ Regulation/ Toxicity ODAP/ Toxicity mechanism ODAP/ Toxicity/ Toxin.

Misra, U. K. and Pandey, C. M. (1994). **H reflex studies in neurolathyrism.** Electroencephalography and Clinical Neurophysiology **93** (4):281-285 (author affiliation: Misra Uk Sanjay Gandhi Postgrad Inst Med Sci Dept Neurol Post Box 375 Lucknow Uttar Pradesh IndiaSanjay Gandhi Postgrad Inst Med Sci Dept Biostat Lucknow Uttar Pradesh India)
Sixteen patients with lathyrism, age ranging between 18 and 55 years and duration of illness between 2 and 25 years, underwent H reflex studies with the aim of studying motor neurone excitability. The patients had marked spasticity (Ashworth score ranging between 2 and 5) and mild to moderate leg weakness. Knee and ankle reflexes were exaggerated in all and the plantar response was extensor in 14 patients. The H reflex abnormalities included increased HM ratio indicating increased motoneurone excitability, significant lack of vibratory inhibition indicating altered transmission in the premotoneuronal portion of the H reflex pathway, and lack of reciprocal inhibition ($P < 0.01$). These H reflex abnormalities were not related to spasticity, weakness, clonus or plantar response. The H reflex recovery curve in 6 patients revealed increased excitability throughout the recovery curve. The secondary facilitation started and peaked slightly earlier than normal, and the late depression was not marked indicating change in excitability of motoneurones or of interneurones. [References: 21].
Source: Copyright Current Contents
H Reflex/ Spasticity/ Paraplegia/ Motor neuron excitability/ Lathyrism/ Neurology/ Age/ Clinical neurophysiology/ Electroencephalography India/ India Uttar Pradesh/ India lathyrism/ Lathyrism India/ Motor neurons/ Neurolathyrism/ Neurons/ Reflexes/ Transmission/ UK/ Uttar Pradesh.

Misra, U. K. and Sharma, V. P. (1994). **Peripheral and central conduction studies in neurolathyrism.** Journal of Neurology, Neurosurgery and Psychiatry **57**:572-577 (author affiliation: Dept of Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow-226 001, India)
To study the involvement of motor and sensory pathways in neurolathyrism, 19 patients with lathyrism from Unnao, India, where lathyrism is endemic, were studied. The mean age of the patients at the time of the onset of illness was 35.8 (range 18-70) years. The mean duration of illness was 15.6 (range 2-30) years. The clinical picture comprised walking difficulty due to stiffness and mild weakness in all 19 patients, cramps in the legs in five, frequency or urgency of micturition in five, and flexor spasms in three. There was pronounced leg spasticity with a mean Ashworth score of 4.1 (range 2.9-5). Central motor conduction to the tibialis anterior muscle (CMCT-TA) was slow in 14 of the 17 patients (21 sides). Slowing of peripheral motor nerve conduction, although less pronounced, was significant in the upper limb in four and in the lower limb in seven sides. The tibial somatosensory evoked potentials were normal and peroneal nerve conduction was marginally impaired. Values for CMCT-TA correlated with the degree of spasticity ($p < 0.02$) whereas weakness, crossed adductor reflexes, and clonus did not. The wide variability of CMCT-TA in lathyrism may be due to involvement of different types of fibres. Large diameter fibre involvement may cause pronounced slowing. Small diameter fibre involvement could produce appreciable spasticity and mild weakness but a lesser degree of slowing or even normal conduction.
Source: Lambein_95_5
Lathyrus/ Lathyrism/ Study of patients/ India Lathyrism/ Lathyrism India/ Symptoms lathyrism/ Neurology/ Lathyrism symptoms/ Age Endemic/ Fibre/ India/ Muscles/ Nerves/ Neurolathyrism/ Peripheral/ Reflexes/ Spasm/ Spasticity.

Moges, G. (1994). **Possibilities of flow-injection immobilised enzyme-based assay for beta-N-oxalyl-L-alpha,beta-diaminopropionic acid**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 97-104.
A successful program of eradicating lathyrism depends primarily on the reliability of measuring ODAP, a neurotoxin found in the seeds of Lathyrus sativus. The present methods of assay for ODAP are slow and do not distinguish the beta-isomer from the nontoxic alpha-form. One approach towards specificity in analysis is to use appropriate enzymes that catalyse the reactions of biomolecules. This presentation examines enzymes that may be used to catalyse the reactions of ODAP and its products, with emphasis on analytical potentials. Rapid assays can be developed by using immobilised (insolubilised) enzyme reactors in flow-injection analysis (FIA) and in post-column detections for high performance liquid chromatography (HPLC). Some FIA results

in measuring pyruvate and ammonia (products of a two-step reaction of ODAP) with immobilised L-lactate dehydrogenase (LDH) and L-glutamate dehydrogenase (GluDH) reactors are discussed.
Source: reprintDE
Enzyme catalysis/ Flow injection analysis/ ODAP/ Enzyme based assay ODAP/ ODAP enzyme assay/ ODAP analysis/ Lathyrus sativus Ammonia/ Bioassay/ Chromatography/ Enzymes/ Ethiopia/ Glutamates/ HPLC/ HTLV/ Injections/ Isomerism ODAP/ Isomerism/ Lactate dehydrogenase/ Lactate/ Lathyrism Bioassay/ Lathyrism Ethiopia/ Lathyrism viral infection/ Neurotoxins/ ODAP isomerism/ Seed/ reprint.

Negere, A. and Mariam, S. W. (1994). **An overview of grass pea (Lathyrus sativus) production in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 67-72.
Source: reprintDE
Lathyrus sativus production Ethiopia/ Ethiopia L. sativus production/ Lathyrus sativus/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ reprint.

Nunn, P. B. (1994). **What molecular mechanisms cause the signs and symptoms of neurolathyrism?** In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 36-43.
Source: reprintDE
Lathyrism mechanisms?/ Neurology/ Lathyrism symptoms/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism mechanisms/ Mechanism Molecular/ Neurolathyrism/ Symptoms lathyrism/ reprint.

Soyka, D. (1994). **Toxic encephalopathies.** Nervenheilkunde **13** (4):149-154 (author affiliation: Soyka D Christian Albrechts Univ Kiel Neurol Klin Niemannsweg 147 D-24105 Kiel Germany)
[German] Many substances may cause both toxic lesions and clinical syndromes related to the central nervous system. In this paper some aspects of pathogenesis as well as diagnostic problems are reviewed. In particular intoxications with some metals and metalloids, gases and organic compounds including solvents are considered. [References: 21].
Source: Copyright Current Contents
Neurotoxicology/ Encephalopathies/ Pathogenesis/ Diagnostic problems/ Nervous-system/ Lathyrism/ Disease/ Lead/ Review.

Tadasse, D. (1994). **Grass pea (Lathyrus sativus): Genetic resources conservation and utilization in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 61-66.
Source: reprintDE
Ethiopia L. sativus genetic resources/ Genetic resources L. sativus Ethiopia/ Lathyrus sativus/ Agriculture/ Genetic resources/ Conservation Ethiopia/ Lathyrism Ethiopia/ Genetic resources L. sativus/ reprint.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kassina, A.; Endeshaw, Y.; Alemu, T., and Spencer, P. S. (1994). **The epidemiology of lathyrism in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 1-9.
Source: reprintDE
Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrism epidemiology/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ reprint.

Tiwari, K. R. (1994) **Inheritance of the neurotoxin beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP) in grass pea (Lathyrus sativus L.) seeds** [MSc thesis]. Winnipeg: Dep. Plant Science, University of Manitoba, 144 pp.
Excellent study and comprehensive review, well worth reading. F2 progeny segregated over entire parental range. ODAP biosynthesis is inherited quantitatively. Cytoplasmic factors appear to be involved. Low x low ODAP crosses resulted in low ODAP progeny. Young seeds contain higher ODAP levels than fully matured seeds! Grass pea (Lathyrus sativus L.) is an important food, feed and fodder legume drought resistant crop. A strong epidemiological association is known to exist between consumption of grass pea and lathyrism. A neurotoxin, $/beta$-N-Oxalyl-L-$/alpha,/beta$-diaminopropionic acid (ODAP) has been identified to be the causative principle. This study was undertaken to investigate the mode of inheritance of the neurotoxin, a prerequisite for the development of neurotoxin free or low neurotoxin lines. Five grass pea lines with low to high ODAP concentration were inter-crossed in all possible combinations (both crosses and reciprocals). Parents, F$/sb1$ and F$/sb2$ progenies were evaluated under field condition and ODAP analyzed by ortho-phthalaldehyde spectrophotometric method. Many of the progenies of low x low ODAP crosses were found to be low in ODAP concentration which indicated that the low ODAP lines shared some genes in common for seed ODAP content. However, wider variation of ODAP in F$/sb2$ progenies as compared to

parental and F$/sb1$ progenies, suggested the presence of different modifier genes between lines. The F$/sb1$ progenies of the low ODAP x high ODAP crosses were intermediate in ODAP concentration which indicated lack of complete dominance either by low or high ODAP. The F$/sb2$ progenies segregated covering the entire parental range. The continuous variation, together with very close to normal distribution of the F$/sb2$ population both of low x low and low x high ODAP, crosses indicated ODAP to be quantitatively inherited. Reciprocal crosses produced different results in some cases indicating a maternal effect on ODAP concentration. Broad sense heritability of ODAP concentration was estimated to be in the range of 17 to 93%.
Source: reprintDE.
ODAP genetics/ Breeding ODAP/ ODAP inheritance/ Genetics ODAP/ Genetics L. sativus/ Lathyrus sativus genetics/ Genetics cytoplasmic factors/ ODAP biosynthesis cytoplasm/ Lathyrus sativus review/ Forage/ Lathyrus sativus/ Agriculture/ Biosynthesis/ Canada/ Climate/ Drought Feed/ Feed Lathyrus sativus/ Fodder/ Food/ Genes/ Genetics/ Heritability/ Lathyrism review/ Manitoba/ Maternal/ Neurotoxins/ O phthalaldehyde/ ODAP/ ODAP biosynthesis/ Population/ Resistance/ Review/ Seed/ reprint.

Trent, M. B. and Boor, P. J. (1994). **Vascular amine oxidase activities during synergistic vasculotoxicity.** Toxicology **89** (1):67-77 (author affiliation: Boor Pj Univ Texas Med Branch Dept Pathol F-05 Galveston, Tx 77555 Usa)
Allylamine (AA) and beta-aminopropionitrile (beta APN) are well known vascular toxins with a demonstrated synergistic toxic effect, i.e. given together they cause extensive smooth muscle cell necrosis of the aortic media. In this study, we investigated the possibility that the enzymes involved in the separate toxicity of AA (semicarbazide-sensitive amine oxidase, or SSAO) and beta APN (lysyl oxidase, or LyO), could be the target(s) of their synergistic toxicity. Adult male Sprague-Dawley rats were given AA alone (AA), 100 mg/kg day, beta APN alone (beta APN), 1 g/kg/day, or both chemicals (AA + beta APN) by gavage for 1, 2, 5 or 10 days. SSAO and LyO were assayed in aorta, lung, and bone. SSAO activity in aortas of rats treated with AA + beta APN showed a maximal decrease (40%) at 10 days; more moderate depression of SSAO was seen in lung and bone, LyO changes were most marked in aorta, where activities were consistently and markedly depressed in all rats receiving beta APN (either alone or in combined treatment). Similarly, the lung and bone LyO activity was depressed at all time points in rats receiving beta APN, but to an apparently lesser degree than in aorta. The most striking changes in in vivo enzyme activities were seen in the aorta, the major target organ in this model. No synergistic effect of the two toxins was seen in the depression of LyO enzyme activity, since there was no difference in the degree of enzyme inhibition present between rats given beta APN alone or AA + beta APN, indicating that inhibition of this enzyme is mainly due to the effect of beta APN. We suggest that AA is the primary toxin in this synergistic vasculotoxic effect. It is likely that some effect of beta APN on AA metabolism or detoxification mechanisms results in synergism. [References: 26].
Source: Copyright Current Contents
Semicarbazide-sensitive amine oxidase/ Lysyl oxidase/ Allylamine/ Beta-aminopropionitrile/ Aorta/ Vascular toxicity/ Smooth-muscle cells Benzylamine oxidase/ Lysyl oxidase/ Allylamine cardiotoxicity/ Beta-aminopropionitrile/ Rat/ Toxicity Lathyrism/ Acrolein/ Invitro.

Tylleskär, T.; Rwiza, H. T.; Banea, M.; Howlett, W. P.; Aquilonius, S.-M.; Persson, L.-A., and Rosling, H. (1994). **Similarities between Konzo and lathyrism suggest a common pathogenetic mechanism**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 26-32. (author affiliation: International Child Health Unit, Department of Neurology, University Hospital, Uppsala, Sweden).
Source: reprintDE
Lathyrism chronic Cassava toxicity/ Lathyrus/ Lathyrism/ Konzo/ Pathogenic mechanism/ Cassava toxicity lathyrism similarities/ Neurology Cassava toxicity/ Child/ Ethiopia/ Lathyrism Ethiopia/ Lathyrism mechanisms/ Lathyrus toxicity/ Humans/ Manihot esculenta/ Cassava Mechanisms toxicity/ Sweden/ Toxicity/ Uppsala/ reprint.

Urga, K.; Fite, A., and Gebre Tsadik, M. (1994). **Influence of processing methods on cooking time and nutritional quality of grass pea**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 105-118.
A simple and convenient procedure has been developed for the preparation of quick-cooking grass pea seeds. When cooked in boiling water, salt solution and wood ash filtrate, pre-soaked grass pea seeds tenderised within 20 and 40 min, respectively. This corresponds to a reduction of 96 % and 84%, respectively, of the time required to cook untreated grass pea seeds. The process also resulted in leaching of solids to the soaking solutions; these increased with the hydration time. During cooking, leaching of solids to the cooking water decreased with the drop in cooking time. Hydration of grass pea seeds prior to cooking also gave a higher drained weight than without hydration. The process also resulted in loss of minerals, protein, phytate and ODAP. The cooked, quick-cooking seeds, however, had a smooth uniform texture, excellent whole-seed appearance, and a pleasing and acceptable flavour. The quick-cooking process thus should find applications in

parts of Ethiopia which are usually fuel-deficient and where dry grass pea seeds are produced as a stable and high protein food commodity.
Source: reprintDE
Lathyrus sativus processing/ Lathyrus sativus cooking/ ODAP/ Lathyrus sativus/ Ash/ Cookery/ Ethiopia/ Flavour/ Food/ Food processing Food processing L. sativus/ Fuel/ Lathyrism/ Lathyrism Ethiopia/ Mineral/ Phytates/ Processing/ Processing methods L. sativus/ Protein/ Quality Seed/ Soaking/ Water/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1994). **Neuroprotective effect of free radical scavengers on beta-n-oxalylamino-l-alanine (BOAA)-induced neuronal damage in rat hippocampus.** Neuroscience Letters **182** (2):159-162 (author affiliation: Willis Cl Inst Psychiat Dept Neurol De Crespigny Pk London Se5 8af EnglandInst Psychiat Dept Neurosci London Se5 8af EnglandUniv London Kings Coll Div Biomed Sci London Wc2r 2ls England)
The neurotoxin beta-N-oxalylamino-L-alanine (BOAA), found in Lathyrus sativus seeds, is thought to be the causative agent of neurolathyrism. We have investigated the neuroprotective effects of free radical scavengers on BOAA-induced toxicity following focal injection (1 mu l) of BOAA and comparing the pathological outcome with the effects of injections of alpha-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA), kainate (KA) or N-methyl-D-aspartate (NMDA) into the dorsal hippocampus of male Wistar rats. Cellular damage was assessed histologically. BOAA (50 nmol) induced a highly selective pattern of hippocampal damage identical with that seen with AMPA (1 nmol). BOAA-induced neurotoxicity, but not AMPA, KA (0.5 nmol) or NMDA (25 nmol)-induced neurotoxicity, was prevented in a dose-dependent manner by focal co-injection of four potential free radical scavengers; dimethyl sulphoxide (DMSO) (1750-7000 nmol), dimethylthiourea (DMTU) (8000 nmol), dimethylformamide (DMF) (7000 nmol) and mannitol(1000 nmol). These findings suggest that hippocampal damage induced by BOAA involves an interaction between AMPA receptors and free radicals. [References: 28].
Source: Reprinted with permisssion (1994) Elsevier Science Ireland Ltd.
ODAP/ DMSO/ Free Radical/ Neurotoxicity/ Neurolathyrism/ Motor neuron disorder/ Excitatory Amino Acid/ Hippocampus/ ODAP toxicity mechanism/ Toxicity ODAP/ Free radical scavengers/ Lathyrism/ Neurology/ Biochemistry/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ AMPA receptors/ Aspartic acid/ England/ Injections/ Kainic acid/ Lathyrism Biochemistry Lathyrism hippocampus/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism rats/ Lathyrus toxicity/ Males/ Mechanisms toxicity Motor neurons/ Neurons/ Neurotoxins/ NMDA/ Prevention lathyrism/ Lathyrism prevention/ Rats/ Receptors/ Rodents/ Seed/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity mechanism ODAP/ Toxicity/ UK.

Wuhib, E.; Tekle Haimanot, R.; Kassina, A.; Kidane, Y., and Alemu, T. (1994). **Survey of grass pea preparation and general dietary intake in rural communities**. Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia, in Addis Ababa, Ethiopia. Published in New York: Third World Medical Research Foundation, pp. 119-126. ISBN: 0-9617775-3-2.
Ethiopian Nutrition Institute, Addis Ababa, Ethiopia; and Faculty of Medicine, Addis Ababa University Addis Ababa, Ethiopia (RTH & TA)Grass pea is a leguminous crop widely consumed in the central highlands of Ethiopia. It is known to have a toxic effect that can manifest as a medico-social problem in a large number of the population. A comprehensive study under the title of 'The Improvement of Lathyrus sativus and the Eradication of Lathyrism' has been conducted by the medico-nutrition group. As part of this study, a household survey on grass pea preparation and general dietary study has been conducted in Dembia and Fogera sub-districts in Gondar administrative region in 1989. The main purpose of the survey was to study methods used in preparation of grass pea for consumption and at the same time, to assess feeding patterns and food intake of the communities. Two farmers associations were selected, namely Shina (grass pea growing) and Muntura (non-grass pea producing). Random samples of 110 and 114 households from Shina and Muntura Farmers' Associations were respectively selected. Information was collected using a pre-tested questionnaire. Standard dietary survey procedure was followed for the dietary study. Information was collected by 10 trained female enumerators under close supervision. Processed data indicate that grass pea is prepared into shiro, nifro, kollo and kitta for consumption. The grass pea is washed whole or split and heat treated in one way or another before preparing into the desired dish. Approximately 80% of the households surveyed have two main meals during the day. The main dishes are thin leavened bread, injera, and sauce, wot. The injera is prepared from finger millet alone or mixed with teff, corn and sorghum. The sauce is prepared from grass pea alone or grass pea mixed with chickpeas.
Source: Lambein_95_5; reprintDE
Lathyrism/ Lathyrism Ethiopia Survey/ Lathyrus sativus preparation/ Lathyrus sativus recipes/ Homeeconomics/ Socioeconomics/ Ethiopia Lathyrus food/ Dietary intake L. sativus Ethiopia/ Human consumption L. sativus Ethiopia/ Economic botany L. sativus/ Culinary aspects INILSEL/ Lathyrus sativus/ Agriculture/ Bread/ Cicer arietinum/ Diet/ Dietary intake/ Economic botany/ Ethiopia/ Feeding/ Female/ Food Heat/ Household/ Human consumption/ Dietary/ Intake/ Lathyrism Ethiopia/ Lathyrism nutrition/ Lathyrus toxicity/ Humans/ Mixtures Nutrition/ Nutrition surveys/ Population/ Rural/ Sorghum/ Surveys/ Toxicity L. sativus/ Toxicity/ reprint.

Ahmad, K. and Jahan, K. (1995). **The role of vitamin C in the prevention of neurolathyrism and detoxification of Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 278.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh lathyrism/ Bangladesh nutrition/ Vitamin C/ Vitamin C lathyrism/ Vitamin C neurolathryism Vitamins/ Lathyrus sativus/ reprint.

Amruth, R. P. and Bhat, R. V. (1995). **Lathyrism in Bidar and Medak districts of South India**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 239-242.
Source: reprintDE
Lathyrism/ Neurolathyrism/ India/ Andhra Pradesh/ Surveys/ Lathyrism epidemiology/ Epidemiology lathyrism/ Lathyrus sativus/ reprint.

Azzi, G.; Safars, M.; Viljanentarifa, E.; Voros, E., and Robert, A. M. (1995). **Effect of the benzquercin treatment on the connective tissue of lathyritic mice - a study by optical and transmission electron microscopy [french].** Pathologie Et Biologie **43** (5):448-460 (author affiliation: Azzi G Univ Paris 07 Fac Sci Equipe Tissu Conjonctif Biol Cellulaire Lab 2 Pl Jussieu F-75251 Paris 05 France)
Vascular pathology is characterized by important alterations of some vessel macromolecular constituants, such as fibrous proteins, collagens and elastin. The purpose of our study was to establish the activity of benzquercin treatment on such alterations of the vascular wall. As experimental model we used lathyrism induced in mice by chronic administration of beta-amino-propionitril (beta-APN). This compound prevents crosslink-formation in elastin and collagen and provokes a disorganisation of the structure and an alteration of the physiological functions of the vascular wall. The connective tissue of the skin is also impaired simultaneously with that of the blood vessels. We compared by optical and transmission electron microscopy the morphological structure of the aorta and the skin of 3 groups of mice : a normal control group, an other which only received the beta-APN alone and a third one which received the beta-APN and the benzquercin treatment. The second group, injected with beta-APN without treatment, showed important alterations of the structure of the aorta as well as of the skin. Both fibrous proteins, collagen and elastin were concerned by these alterations, the consequence of which was an increase of the permeability of the aorta wall demonstrated with the horse-radish peroxydase as a tracer. The third group, injected with beta-APN and treated with the benzquercin, showed much less morphological disorders than the untreated group and the vascular permeability was also close to normal controls. These results are in favour of a corrective effect of benzquercin treatment on fibrous proteins of connective tissue and may represent one of the components of the therapeutic effects observed in the clinical trials of this drug. [References: 19].
Source: Copyright Current Contents
Benzquercin/ Beta-apn/ Lathyrism/ Crosslinks/ Reticulation of collagen/ Reticulation of elastin/ Vascular permeability/ Procyanidolic oligomers.

Bell, E. A. (1995). **Complementary approaches to the improvment of Lathryus sativus and the elimination of lathyrism**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 249-253.
Source: reprintDE
Poverty/ Genetics/ Malnutrition/ ODAP/ Lathyrus sativus/ Neurolathyrism/ Australia/ Canada/ Lathyrus sativus low ODAP/ Outcrossing Biochemistry/ reprint.

Briggs, C. J.; Campbell, C. G., and Castell, A. G. (1995). **Analysis of grass pea, Lathryus sativus, and its evaluation as a component of animal feed**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 81-84.
Use of Lathyrus sativus (L) seed as a component of pig feed was evaluated. Effects on growth, carcass quality and major organs were assessed. There was some reduction in rate of weight gain, but results with up to 20% lathyrus in feed were acceptable for commercial use.
Source: reprintDE
Pigs/ ODAP analysis/ Carcass quality/ Nutrition animal/ Feed/ Lathyrus sativus feed/ Lathyrus sativus/ Canada/ reprint.

Campbell, C. G. and Deshpande, S. S. (1995). **Breeding grass pea (Lathyrus sativus) for increased nutritive value**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 167-172.
Source: reprintDE
Phenols/ Polyphenols/ Protease inhibitor/ Protease inhibitors L sativus/ Tannins/ Trypsin inhibitor/ Amylase inhibitor/ Chymotrypsin inhibitor ODAP/ Nutrition/ Nutritive value/ Lathyrus sativus/ Canada/ Breeding/ Lathyrus sativus low ODAP/ reprint.

Chowdhury, B.; Hussain, M., and Wouters, G. (1995). **Comparative study of the OPT method for the neuotoxin ODAP as modified by various laboratories**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 284.
Source: reprintDE
ODAP/ O Phthalaldehyde/ ODAP analysis/ ODAP chemistry/ Analysis ODAP/ Lathyrus sativus/ reprint.

Chowdhury, S. D. (1995). **Lathyrus in poultry feeding - some recent findings**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 235-238.
Source: reprintDE
Poultry/ Lathyrus sativus/ Feed/ Lathyrus pusillus/ Lathyrus odoratus/ Lathyrus hirsutus/ BAPN/ Beta aminopropionitrile/ ODAP/ Review reprint.

Cohn, D. F. (1995). **Are other systems apart from the nervous system involved in human lathyrism?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 101-102.
Twenty five years of following lathyrism patients, who were exposed in 1942 to the grass pea (Lathryus sativus), point to the fact that not only the central nervous system is involved, but the skeleton, the peripheral nerves and the cornea may also be affected in some patients. It is therefore suggested that the term Human Lathyrism Syndrome (HULAS) be coined for the condition in man.
Source: reprintDE
Osteolathyrism/ Neurolathyrism/ Skeleton/ Ukraine/ Israel/ Lathyrism/ Cornea/ Peripheral nervous system/ Human Lathyrism Syndrome Lathyrus sativus/ reprint.

Datta, A. (1995). **Strategy to develop transgenic Lathyrus with low level neurotoxin by recombinant DNA technology**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 173-176.
Source: reprintDE
Molecular biology/ Lathyrus sativus/ Lathyrus sativus genetics/ Lathyrus sativus low ODAP/ India/ Oxalate decarboxylase/ reprint.

De Bruyn A. and Nunn, P. B. (1995). **Involvement of an imidazolidine derivative during the rearrangement of the neurotoxin beta-ODAP**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 25-30.
Source: reprintDE
Isomerism/ Chemistry/ ODAP/ Alpha-ODAP/ ODAP chemistry/ Chemistry ODAP/ NMR/ Imidazolidine/ Lathyrus sativus/ reprint.

De Bruyn A.; Van Haver, D.; Nunn, P. B., and Abegaz, B. M. (1995). **Comparison of the experimental and calculated conformations of beta-ODAP**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 281.
Source: reprintDE
ODAP/ ODAP chemistry/ ODAP structure/ NMR/ NMR characteristics ODAP compounds/ Lathyrus sativus/ reprint.

Dibabe, A. (1995). **Grain yield and ODAP content of some grass pea cultivars in Ethiopia**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 139-143.
Source: reprintDE
ODAP screening/ Ethiopia/ Lathyrus sativus/ Ethiopia L. sativus/ Ethiopia L sativus improvement/ Ethiopia L. sativus genetic resources Lathyrus sativus Genetic resources screening/ Yield/ Yield L. sativus/ Genetic resources/ Genetic resources evaluation/ reprint.

Düsünceli, F. (1995). **Prospects for production of Lathyrus sativus and L. cicera in Southeast Anatolia in Turkey**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 131-137.
Source: reprintDE
Lathyrus sativus/ Lathyrus cicera/ Turkey/ Anatolia/ Forage/ Seed yield/ Agronomy/ Genetic resources evaluation/ ODAP screening/ Yield Yield fodder/ Yield L. sativus/ Yield L. cicera/ Genetic resources/ reprint.

Dwivedi, M. P. (1995). **Legal aspects of cultivation and consumption of Lathyrus sativus in India**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 51-54.
Source: reprintDE
Legislation/ Lathyrus sativus ban India/ India/ Lathyrus sativus/ reprint.

Enneking, D. (1995). **Post-harvest detoxification: the key to alternative Vicia grain legumes?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 85-92.
Vicia sativa, V. narbonensis, V. ervilia and V. articulata (syn. V. monantha) are well suited for Mediterranean dryland agriculture. The use of these species as grain legumes has been largely restricted to the supplemental feeding of ruminants and draft animals, and in times of famine, this use has sometimes been extended to human consumption. We have studied the unpalatability of V. villosa and V. narbonensis grain, using a porcine feed-intake bioassay. Two different antifeedant principles were isolated. The seed of V. villosa contains the toxic arginine analogue, canavanine1 and that of V. narbonensis the dipeptide gamma glutamyl S-ethenyl-cysteine2, which incidentally is analogous to the flavour precursor, gamma glutamyl S-prop-1-enyl-cysteine present in chives (Allium schoenoprasum)3. V. villosa is not a grain legume, but a forage crop. Other species, such as V. articulata and V. ervilia which do also contain canavanine in their seeds are used as grain legumes for supplemental feeding of ruminants. Their use as food for monogastric animals and humans is limited by the presence of canavanine. V. sativa contains the favism toxin, vicine, as well as the neurotoxic and antinutritional cyanoamino acids, ß-cyanoalanine and gamma glutamyl ß-cyanoalanine. The antinutritional non-protein amino acids in V. sativa and V. narbonensis can be inactivated by mild acid hydrolysis2. Under alkaline conditions, canavanine degrades to deamino-canavanine which is inactive in the bioassay1 Thus, in principle, the major undesirable non protein amino acids in Vicia spp. seeds, can be inactivated by either acidic or alkaline chemical processes. In view of the biological functions for these factors in the ecology of Vicia spp., it appears that post-harvest detoxification could well be the best long-term option for the sutainable development of these crops. Traditional utilisation practices and preparative methods for Vicia grain should now be assessed in detail for their effectiveness in minimising the ingestion of these factors whilst preserving their nutritive properties. Innovative application of this knowledge can reasonably be expected to provide the basis for the wider utilisation of Vicia spp. as grain legumes. 1. Enneking, D. Giles, L. C., Tate, M. E., Davies, R. L. (1993). L-canavanine: a natural feed-intake inhibitor for pigs (isolation, identification and significance) J. Sci. Food Agric. 61, 315-325 2. Enneking, D. 1994, The toxicity of Vicia species and their utilisation as grain legumes. PhD thesis. University of Adelaide, South Australia 3. Mattikala, E J. & Virtanen, A. I. (1962). A new g-glutamylpeptide, g-L-glutamyl-S-(prop-1-enyl)-L-cysteine, in the seeds of chives (Allium schoenoprasum). Acta Chem. Scand. 16, 2461-2462.
Source: reprintDE
Vicia spp toxicity/ Postharvest detoxification/ Vicia sativa/ Vicia narbonensis/ Vicia villosa/ Canavanine/ gamma glutamyl S-ethenyl-cysteine South Australia/ Famine foods/ Famine/ Malnutrition/ Antinutritional factors/ Forage/ Lathyrus sativus/ Bioassay/ NPAA gamma glutamyl peptides/ Agriculture/ Beta cyanoalanine/ Allium/ Amino acids/ Arginine/ Australia/ Chemistry/ Cysteine/ Detoxification/ Dissertations Distribution plants/ Dryland/ Ecology/ Favism/ Feed/ Feeding/ Feed ruminants/ Feed Vicia sativa/ Feed Lathyrus sativus/ Feed Lathyrus ochrus Flavour/ Food/ Gamma glutamyl peptides/ Gamma glutamyl beta cyanoalanine/ Grain legumes/ Pulses/ Human consumption/ Intake/ Isolation Lathyrism animals/ Lathyrism Bioassay/ Lathyrus ochrus/ Lathyrus toxicity/ Humans/ Mediterranean/ Monogastric/ Neurotoxins/ NPAA NPAA chemistry/ Peptides/ Pigs/ Postharvest/ Protein/ Ruminants/ Ruminant feed/ Ruminants L. sativus/ Seed/ Sulfur amino acids/ Toxicity L. sativus/ Toxicity/ Toxin/ Utilisation/ Vicia spp/ Vicia/ Vicia ervilia/ Vicia articulata/ Vicia monantha/ Vicine/ reprint.

Geda, A. K.; Pandey, R. L., and Agrawal, R. K. (1995). **Environmental influence on ODAP content in Lathyrus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 221-223.
Source: reprintDE
ODAP/ ODAP environmental variation/ India/ India L. sativus/ Lathyrus sativus/ Lathyrus sativus India/ Rabi/ IARI/ Lathyrus sativus low ODAP/ Environmental effects/ Environment x genotype/ reprint.

Gutierrez, J. F. and Vences, F. J. (1995). **Genetic and physiological studies in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 189-199.
Source: reprintDE
Genetics/ Physiology/ Lathyrus sativus/ Spain/ RAPD/ Isozymes/ HPLC/ ODAP/ Linkage analysis/ Lathyrus sativus low ODAP/ reprint.

Haque, A. and Hossain, M. (1995). **Role of tolperisone in lathyrism**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 119-126.
Source: reprintDE
Neurolathyrism/ Muscle relaxant lathyrism treatment/ Muscles/ Tolperisone lathyrism treatment/ Lathyrus sativus/ reprint.

Haque, A.; Hossain, M.; Lambein, F., and Bell, E. A. (1995). **Occurrence of osteolathyrism among neurolathyrism patients in Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 273.

60 of 500 neurolathyrism patients complained of bone pain and showed skeletal deformities. 2 of these were found to have skeletal damage (failure of fusion in both vertebral and iliac epiphyses). Of the 60, all were familiar with the consumption of seeds and green parts of Lathyrus sativus, the latter of which contain 2-cyanoethyl-isozazolin-5-one, a compound that chemically and metabolically can osteolathyrogen beta-aminopropionitrile.
Source: reprintDE
Osteolathyrism/ Neurolathyrism/ Bangladesh/ BAPN/ Isoxazolin-5-one/ Isoxazolin-5-one toxicity/ Beta aminopropionitrile/ Beta aminopropionitrile toxicity/ Lathyrus sativus/ reprint/ 2 Cyanoethylisoxazolin 5 one/ NPAA 2-(2-cyanoethyl)-3-isoxazolin-5-one.

Haque, A.; Hossain, M.; Wouters, G.; Kuo, Y. H., and Lambein, F. (1995). **Study on some socio-economic aspects of lathyrism patients in two North-Western districts of Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 63-68.
Source: reprintDE
Bangladesh economics/ Bangladesh/ Bangladesh L. sativus/ Bangladesh lathyrism/ Bangladesh nutrition/ Bangladesh poverty/ Bangladesh socioeconomics/ Socieconomics Bangladesh/ Socieconomics L. sativus/ Socioeconomic constraints/ Socioeconomic Factors/ Socioeconomics Socioeconomics Bangladesh/ Socioeconomics L. sativus/ Lathyrus sativus/ reprint.

Haque, A.; Kebede, N.; Kuo, Y. H.; Hussain, M., and Lambein, F. (1995). **Effect of nutrient elements and environmental factors on ODAP and other amino acids content in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 276.
Source: reprintDE
ODAP/ ODAP environmental variation/ ODAP Zinc/ ODAP drought stress/ Drought/ Drought stress/ Drought stress effect on ODAP/ Drought stress L. sativus/ Salinity/ Nutrient manipulation Zinc/ Nutrients/ Nutrition plant/ Lathyrus sativus/ reprint.

Haque, A.; Khan, J. K.; Wouters, G.; Hossain, M., and Lambein, F. (1995). **Low frequency of HTLV-1 antibodies in neurolathyrism patients in Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 283.
Source: reprintDE
Neurolathyrism/ HTLV/ HTLV 1/ HTLV-1 lathyrism/ Bangladesh/ Bangladesh lathyrism/ Lathyrus sativus/ reprint.

Haque, A.; Khan, J. K.; Wouters, G.; Hossain, M., and Lambein, F. (1995). **Study of HTLV-I antibodies in CSF and serum of neurolathyrism patients in Bangladesh.** Annales De La Societe Belge De Medecine Tropicale **75** (2):131-134
Neurolathyrism is a form of human spastic paraparesis related to the overconsumption of the legume Lathyrus sativus or grass pea (Khesari in Bangladesh) containing the neurotoxin 3-N-oxalyl-2,3-diaminopropanoic acid (beta-ODAP). The clinical symptoms of neurolathyrism are similar to those of Tropical Spastic Paraparesis, In order to eliminate the proposed causative agent of TSP (HTLV-I) as a potential cause of the symptoms ascribed to neurolathyrism, a total of 444 diagnosed lathyrism patients were screened for HTLV-I antibodies. 50 CSF and 394 serum samples were collected from male (415) and female (29) patients. Only 4 serum samples were found sere-positive for HTLV-I. This agrees with the assumption that overconsumption of beta-ODAP containing Lathyrus seeds, and not HTLV infection, is the causative agent for neurolathyrism.
Source: Reprinted with permission of the authors
Neurolathyrism/ Tropical Spastic Paraparesis/ HTLV 1/ Cerebrospinal Fluid/ ODAP/ Bangladesh lathyrism/ Neurology/ Lathyrus sativus Lathyrism symptoms/ Antibodies/ Bangladesh/ Female/ Belgium/ HTLV/ Immunology/ Infection/ Khesari/ Lathyrism/ Lathyrism Bangladesh Lathyrism cerebrospinal fluid/ Lathyrism serum/ Lathyrism viral infection/ Males/ Humans/ Neurotoxins/ Seed/ Spasticity/ Spastic paraparesis Symptoms lathyrism/ Tropics.

Haque, R.; Kuo, Y. H., and Lambein, F. (1995). **Effect of zinc and iron on the biosynthesis of ODAP in callus tissue of Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 282.
Fe 2+ and Zn 2+ ions can modulate the biosynthesis of ODAP.
Source: reprintDE
ODAP/ ODAP Zinc/ Tissue culture/ Callus/ Callus culture/ Zinc/ Iron/ Lathyrus sativus/ Lathyrus sativus biochemistry/ Biochemistry Biosynthesis ODAP/ Biosynthesis/ ODAP biosynthesis/ reprint.

Hussain, M. and Chowdhury, B. (1995). **Agro-ecological factors affecting the concentration of beta-N-oxalyl-alpha,beta-diaminopropionic acid (ODAP) in Lathyrus sativus seed**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 201-209.
Source: reprintDE

Environmental effects/ Environment x genotype/ Salinity/ Water stress/ ODAP/ ODAP environmental variation/ Fertiliser/ Micronutrients Trace elements/ Water/ Water relations/ Lathyrus sativus/ reprint.

Ikegami, F.; Kuo, Y. H.; Lambein, F., and Murakoshi, I. (1995). **Biosynthesis in vitro of some Lathyrus toxins**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 1-13.
Source: reprintDE
Lathyrus sativus/ NPAA biosynthesis/ In vitro/ Biosynthesis/ Isoxazolin-5-one/ Biochemistry L. sativus/ Toxin/ Toxin biosynthesis/ reprint.

Junaid, M. A.; Jain, R. K., and Rao, S. L. N. (1995). **Binding of ODAP to chick synaptic membranes**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 31-40.
Source: reprintDE
Synapses/ Synaptic Membranes metabolism/ ODAP receptors/ Neurology/ Biochemistry/ Lathyrus sativus/ reprint.

Kaul, A. (1995). **Concluding remarks and recommendations**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 269-271.
Source: reprintDE
Strategy/ Recommendations/ Lathyrus sativus/ reprint.

Kebede, N.; Kuo, Y. H.; Khan, J. K., and Lambein, F. (1995). **Influence of nutrient status for cultivation of Lathryus sativus and level of the neurotoxin ODAP: A link between environment and toxicity?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 211-214.
Source: reprintDE
Environmental effects/ Environment x genotype/ Sulfur/ Cysteine Synthase/ ODAP environmental variation/ Belgium/ Lathyrus sativus Toxicity L. sativus/ Toxicity ODAP/ Toxicity/ reprint.

Khan, J. K.; Kebede, N.; Kuo, Y. H., and Lambein, F. (1995). **High-performance liquid chromatographic separation of the toxins and some non-protein amino acids in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 69-72.
Source: reprintDE
NPAA analysis/ NPAA chemistry/ Isoxazolin-5-one/ HPLC/ ODAP/ Lathyrus sativus chemistry/ Chemistry/ Toxin/ Lathyrus sativus/ reprint.

Khan, J. K.; Kuo, Y.-H.; Haque, A., and Lambein, F. (1995). **Inhibitory and excitatory amino acids in cerebrospinal fluid of neurolathyrism patients, a highly prevalent motorneurone disease**. Acta Neurologica Scandinavica **91**:506-510.
Data are presented which suggest a disturbance of amino acid metabolism caused through the consumption of L. sativus/ and associated factors. Glu, Tau, Gly were higher in lathyrism patients.
Source: reprintDE; reprinted with permission Copyright 1995 Munksgaard Publishers, Copenhagen
Cerebrospinal fluid amino acid analysis/ Lathyrism CSF aa profile/ Lathyrism patients/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids analysis/ Cerebrospinal fluid/ Excitatory amino acid/ Lathyrism/ Lathyrism cerebrospinal fluid/ Metabolism plant/ Motor neurons Neurolathyrism/ Neurons/ Prevalence/ reprint.

Khan, J. K.; Kuo, Y. H.; Haque, A., and Lambein, F. (1995). **Neurotransmitters in the cerebrospinal fluid and serum of neurolathyrism patients**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 111-117.
Source: reprintDE
Cerebrospinal fluid/ Cerebrospinal fluid amino acid analysis/ Human consumption L. sativus/ Neurolathyrism/ Neurologic Examination Neurology/ Neurotoxins/ Neurotoxins analysis/ Glutamates/ Glycine/ Lathyrus sativus/ reprint.

Khawaja, I.; Khawaja, H. I. T.; Ullah, I.; Raja, N. U., and Khushk, A. M. (1995). **Lathyrism in Pakistan: A preliminary survey**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 55-62.
Source: reprintDE
Pakistan/ Pakistan L. sativus/ Lathyrism epidemiology/ Lathyrism Pakistan/ Lathyrus sativus production/ ODAP/ Surveys/ Socioeconomics Lathyrus sativus/ reprint.

Kuo, Y. H.; Bau, H.-M.; Khan, J. K., and Lambein, F. (1995). **Detoxification of Lathyrus sativus meal by fermentation without loss of nutritive value**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 231-234.
Source: reprintDE

Fermentation/ Fermentation L. sativus/ Fermentation L. sativus detoxification/ Aspergillus oryzae/ Rhizopus oligosporus/ SDS PAGE/ Protein Protein electrophoresis/ ODAP/ ODAP analysis/ Nutrition/ Nutritive value/ Processing/ Processing L. sativus/ Processing methods L. sativus Tempeh/ Post harvest processing L. sativus/ Postharvest detoxification/ Detoxification/ Detoxification L. sativus/ Detoxification L. sativus fermentation/ Lathyrus sativus/ reprint.

Kuo, Y. H.; Khan, J. K., and Lambein, F. (1995). **Biosynthesis in vivo of the neurotoxin beta-ODAP in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 15-20.
Source: reprintDE
Lathyrus sativus/ NPAA biosynthesis/ In vivo/ Biosynthesis/ ODAP biosynthesis/ Biochemistry L. sativus/ Biosynthesis ODAP/ ODAP Biochemistry/ reprint.

Kuo, Y. H.; Lambein, F.; Mellor, L. C.; Adlington, R. M., and Baldwin, J. E. (1995). **Biosynthesis of the neurotoxin beta-ODAP in callus tissue of Lathryus sativus: Incorporation of [N] - and [C] - precursors**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 21-24.
Source: reprintDE
Lathyrus sativus/ ODAP biosynthesis/ Biosynthesis ODAP/ Biochemistry/ reprint.

Lambein, F. (1995). **Collaborative projects on Lathyrus and human lathyrism coordinated by the University of Ghent, Belgium: Prospects for further research**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 261-267.
Source: reprintDE
BIA/ ODAP/ Lathyrus sativus low ODAP/ NATO/ EEC/ Isoxazolin-5-one/ Bangladesh/ Belgium/ ODAP/ Biosynthesis/ Biochemistry Lathyrus sativus/ reprint.

Mehra, R. B.; Raju, D. B., and Hima Bindu, K. (1995). **Breeding work on Lathyrus sativus L. at I.A.R.I., New Delhi**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 127-130.
Source: reprintDE
Genetic resources/ Genetics/ Genetics flower colour/ Polymorphism L. sativus/ Polymorphisms/ Flower colour polymorphism/ Flower colour ODAP/ ODAP L. sativus/ ODAP screening/ India/ Genetic resources L. sativus/ Lathyrus sativus/ reprint.

Mehta, S. L. (1995). **Strategies for toxin removal from Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 275.
Source: reprintDE
Somaclones/ Somaclones L. sativus/ ODAP/ Lathyrus sativus low ODAP/ India/ Lathyrus sativus/ reprint.

Moges, G.; Johansson, G., and Solomon, T. (1995). **Determination of the neurotoxic amino acid ODAP using a redox enzyme, glutamate oxidase, in batch-wise or flow injection mode**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 73-79.
Source: reprintDE
ODAP analysis/ Analysis ODAP/ Glutamate oxidase/ Lathyrus sativus/ Biochemistry/ reprint.

Narayan, R. K. J.; Getachew, A., and Jadhav, A. (1995). **Genetic manipulation of the biosynthesis of beta-N-oxalyl-L-alpha, beta-diaminopropionic acid (beta-ODAP) in Lathyrus sativus: Problems and prospects**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 177-187.
Source: reprintDE
ODAP/ Molecular biology/ Genetics/ Lathyrus sativus/ ODAP biosynthesis/ Phenology/ Tissue culture/ Callus culture/ reprint.

Nunn, P. B.; Perera, K. P. W. C., and Bell, E. A. (1995). **Blood and urine analyses following the consumption of Lathyrus sativus seed by human volunteers**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 103-110.
Source: reprintDE
Human consumption L. sativus/ Human metabolism ODAP/ ODAP/ ODAP bioassay/ ODAP metabolism/ Volunteers/ Lathyrus sativus/ reprint.

Pandey, R. L. and Kashyap, O. P. (1995). **Studies on socio-economic strata and Lathryus consumption in Rural Madhya Pradesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 47-50.

Source: reprintDE
Madhya Pradesh/ India/ Rural/ Socioeconomics/ Socioeconomics L. sativus/ Socioeconomics lathyrism/ Nutrition/ Nutrition L. sativus Nutrition surveys/ Dhal/ Surveys/ Lathyrus sativus/ reprint.

Pooder, A. K. (1995). **Studies on the growth and physiology of Lathyrus nodule bacteria**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 277.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh L. sativus Rhizobium/ Lathyrus sativus/ Lathyrus sativus Rhizobium/ Rhizobium/ Rhizobium leguminosarum/ Rhizobium L. sativus/ reprint.

Rahman, M. K.; Sarker, M. A. H.; Uddin, M. A., and Naved, A. F. (1995). **Effect of Lathyrus sativus and vitamin C on the activities of aromatic L-amino acid decarboxylase and dipeptidyl aminopeptidase-IV in the central and peripheral tissues and serum of guinea pigs**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 243-247.
Source: reprintDE
Vitamin C/ Armoatic amino acid decarboxylase/ Amino acids metabolism/ Guinea Pigs/ Peripheral/ Peripheral nervous system/ Serum Dipeptidyl aminopeptidase/ Aminopeptidase/ Lathyrus sativus/ ODAP toxicity/ Toxicity L. sativus/ Toxicity ODAP/ Toxicity/ Vitamins/ reprint.

Rahman, M. M.; Quader, M.; Rahman, A.; Sarker, A.; Kumar, J.; Yusuf, H. K. M., and Malek, M. A. (1995). **Recent advances in breedin glow toxin khesari lines at BARI**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 153-160.
Source: reprintDE
BARI/ Bangladesh L. sativus/ Bangladesh L. sativus genetic resources/ Breeding/ Breeding L. sativus/ Breeding ODAP/ ODAP/ ODAP screening/ Genetic resources evaluation/ Lathyrus sativus low ODAP/ Toxin/ Genetic resources/ Lathyrus sativus/ reprint.

Roy, B. C.; Yusuf, H. K. M.; Khan, L. A.; Wouters, G.; Khan, J. K., and Lambein, F. (1995). **BIA toxicity in day-old chicks**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 280.
Source: reprintDE
BIA/ Beta (Isoxazolin 5 on 2 yl) L Alanine/ BIA toxicity/ Bioassay/ Bioassay chicks/ Poultry/ Poultry bioassay/ Lathyrus sativus/ reprint.

Sarwar, C. D. M.; Sarker, A.; Murshed, A. N. M. M., and Malek, M. A. (1995). **Variation in natural population of grass pea**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 161-164.
Source: reprintDE
Lathyrus sativus Bangladesh/ Lathyrus sativus genetic resources/ Lathyrus sativus genetic variation/ Bangladesh/ Bangladesh L. sativus Bangladesh L. sativus genetic resources/ Bangladesh ODAP/ ODAP/ Flower colour/ Genetic resources collecting/ Genetic resources/ Genetic resources L. sativus/ Genetic resources evaluation/ Lathyrus sativus/ reprint.

Shaikh, M. A. Q.; Majid, M. A., and Lahiri, B. P. (1995). **Mutant derivative low neurotoxin lines of grass pea (Lathyrus sativus)**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 165-166.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh ODAP/ Mutagenesis/ Mutagenesis breeding L. sativus/ Mutants/ Lathyrus sativus/ reprint.

Swarup, I. and Lal, M. S. (1995). **Reaction of Lathyrus genotypes to powdery mildew (Erysiphe polygoni DC) under 'Upland conditions'**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 286.
Source: reprintDE
Powdery mildew/ Erysiphe polygoni/ Erysiphe/ India/ Phytopathology L. sativus/ Phytopathology/ Mycology/ Diseases plant/ Diseases L. sativus/ Lathyrus sativus/ reprint.

Tate, M. E.; Enneking, D.; Delaere, I.; Malaterre, C., and Glatz, P. C. (1995). **Towards the detoxification of Vicia sativa L.** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 93-100.
Cultivars of Vicia sativa L. contain the favism toxin vicine, as well as gamma-glutamyl-beta cyanoalanine and in some cases the cyanogenic glycoside vicianine. Reports of the rising human consumption of Vicia sativa: cultivars with orange coloured cotyledons, such as the Vicia sativa cultivar Blanche Fleur, which mimics the colour and size of red lentils (Lens culinaris Medik) have stimulated the search for low toxin lines and detoxification procedures. Diffuse Reflectance Using Infrared Dispersion (DRUID) spectroscopy of the

absorbance of the nitrile group (-CN) near 2250 cm-1 provides a useful method for monitoring its presence in food or feed samples and also its loss during in situ acid catalysed hydrolysis of the seeds. It will also be important for screening germplasm.
Source: reprintDE
Vicia spp toxicity/ Postharvest detoxification/ Vicia sativa/ Poultry bioassay/ Layers/ Feed intake/ Egg production/ Poultry bioassay/ Lathyrus sativus/ Bioassay/ NPAA gamma glutamyl peptides/ Agriculture/ Genetic resources/ Beta cyanoalanine/ Beta Alanine analogs and derivatives Colour/ Cotyledons/ Cultivars/ Detoxification/ Dietary intake/ Dispersion/ Eggs/ Favism/ Feed/ Feed Vicia sativa/ Feed Lathyrus sativus/ Food Gamma glutamyl beta cyanoalanine/ Gamma glutamyl peptides/ Glycosides/ HCN/ Human consumption/ Hydrolysis/ Diet/ Dietary/ Intake Lathyrism Bioassay/ Lathyrus toxicity/ Layers/ Lens culinaris/ Humans/ Nitriles/ NPAA/ Peptides/ Postharvest/ Poultry/ Reports/ Screening Seed/ Toxicity L. sativus/ Toxicity/ Toxin/ Vicia spp/ Vicia/ Vicine/ reprint.

Tekle Haimanot, R.; Abegaz, B. M.; Wuhib, E.; Kassina, A.; Kidane, Y.; Kebede, N.; Alemu, T., and Spencer, P. S. (1995). **Nutritional and neuro-toxicological surveys of Lathryus sativus consumption in Northern Ethiopia**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 41-45.
Source: reprintDE
Socioeconomics/ Socioeconomics L. sativus/ Processing/ Processing methods L. sativus/ Production L. sativus/ Ethiopia/ Ethiopia L. sativus Ethiopia lathyrism/ Ethiopia Lathyrus food/ Ethiopia nutrition/ Ethiopia nutritional survey/ Lathyrus sativus/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1995). **Neuronal damage, induced by beta-ODAP in rat hippocampus, can be prevented by the non-NMDA antagonist 2,3-dihydroxy-6-nitro-7-sulphamoyl-benzo(F)quinoxaline (NBQX)**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 285.
Results indicate that the acute in vivo hippocampal toxicity if beta-ODAP in the rat is mediated by AMPA receptors, rather than by KA or NMDA receptors. Neurones in the rat hippocampus did not die immediatley on exposure to beta-ODAP, but via a process involving sustained AMPA receptor activation. It is proposed that excitotoxic processes acting via AMPA receptors may play a role in the loss of upper motor neurones that occurs in neurolathyrism.
Source: reprintDE
ODAP/ ODAP toxicity mechanism/ NMDA/ NMDA receptors/ AMPA receptors/ KA receptors/ Neurology/ Neurons/ Neurotoxicity/ Rats Rodents/ Neurolathyrism/ NBQX/ Lathyrus sativus/ reprint.

Wouters, G.; Lambein, F.; Haque, A.; Hussain, M., and Yusuf, H. K. M. (1995). **Progress and prospects in the Bangladesh/Belgium Inter-University project**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 255-260.
Source: reprintDE
Lathyrus sativus/ Bangladesh/ Belgium/ HTLV-1/ Osteolathyrism/ Epidemiology lathyrism/ Lathyrism epidemiology/ Demography Socioeconomics/ ODAP analysis/ Poultry bioassay/ Zinc/ Environmental effects/ Trace elements/ reprint.

Yadav, C. R. and Neupane, R. K. (1995). **Genetic evaluation and breeding program of grass pea in Nepal**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 274.
Source: reprintDE
Lathyrus sativus/ Lathyrus sativus breeding/ Nepal/ Nepal L. sativus/ reprint.

Yu, Jing-Zhong (1995). **Cultivation of grass pea and selection of lower toxin varieties and species of Lathyrus in China**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 145-151. (author affiliation: The Soil and Fertilizer Institute, Academy of Agricultural Sciences Yangling, Shaanxi 712100, P.R. of China).
Our results show that the grass pea (Lathyrus sativus L.) is tolerant to drought and barren land, and that it is resistant to pea weevil.About 20,000 ha of grass pea were grown in North Shaanxi in recent years, with a stable yield 20% higher than pea (Pisum sativum L.). Human lathyrism was a serious problem in the Chinese province of Gansu in the seventies.The same varieties grown in different localities produced seeds with the same content of ODAP. From 50 varieties of L. sativus (with 0.03 to 0.87% ODAP) we selected six varieties with toxin content of 10.2%, giving virtually no visible symptoms in young chicks. One species of Lathyrus was found to be free of ODAP. Different varieties of grass pea or different species of Lathyrus have different compositions of esterase isozymes. This variability may be useful as a method to identify grass pea varieties, to select the parents for cross-breeding as a strategy for developing lower toxin varieties of Lathyrus sativus.
Source: reprintDE
Lathyrus sativus/ Lathyrus cicera/ Lathyrus latifolius/ Lathyrus odoratus/ Lathyrus sativus China/ Lathyrus sativus low ODAP/ Lathyrus sativus ODAP/ Lathyrus sativus ODAP screening/ Lathyrus sylvestris/ China/ China Shaanxi/ China Gansu/ Shaanxi/ Gansu/ China L. sativus

China L. sativus chemical analysis/ China L. tingitanus/ Toxin/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Yield/ Yield L. sativus Yield L. cicera/ reprint.

Yusuf, H. K. M.; Haque, K.; Uddin, A.; Roy, B. C., and Lambein, F. (1995). **Homoarginine antagonises the toxicity of Lathyrus toxin in 1-day-old chicks.** Bangladesh Journal of Physiology and Pharmacology **10** (2):74-75 (author affiliation: Biochemistry (Human Nutrition Lab.) University of Dhaka, Dhaka 1000, Bangladesh; and Laboratory of Physiological Chemistry, University of Ghent, B-9000 Ghent, Belgium) Meeting abstract.
Source: Lambein_95_5; reprintDE
Lathyrus sativus toxicity/ Lathyrism/ Chick bioassay-ODAP antagonism/ Antagonism ODAP-homoarginine/ ODAP-homoarginine antagonism ODAP toxicity/ Biochemistry/ Lathyrus sativus/ Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Antagonism amino acids Bangladesh/ Chemistry/ Chickens/ Belgium/ Homoarginine/ Lathyrism Bangladesh/ Lathyrism Bioassay/ Lathyrism Biochemistry/ Lathyrism nutrition/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Humans/ Nutrition/ ODAP/ Physiology not plant/ Phytochemistry/ Poultry/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Toxin/ reprint.

Yusuf, H. K. M.; Roy, B. C.; Khan, L. A; Al-Monsoor, M. M.; Sarker, S.; Mohiduzzaman, M., and Quazi, S. (1995). **Studies on a toxin-free Lathyrus protein concentrate**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 225-230.
Source: reprintDE
Post harvest processing L. sativus/ Protein isolates/ Protein L. sativus/ Protein quality L. sativus/ Protein quality/ Digestibility/ Amino acid composition/ Nutritive value/ Lathyrus sativus/ Bangladesh/ Toxin/ reprint.

Yusuf, H. K. M.; Roy, B. C.; Sarkar, S.; Wouters, G., and Lambein, F. (1995). **ODAP toxicity in chicks: zinc appears to have a protective role**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 279.
Source: reprintDE
ODAP/ ODAP toxicity ions/ ODAP Zinc/ Zinc/ Zinc lathyrism/ Poultry/ Chick bioassay/ Chickens/ Bangladesh/ Bangladesh lathyrism Bangladesh nutrition/ Lathyrus sativus/ reprint.

Haque, A.; Hossain, M.; Wouters, G., and Lambein, F. (1996). **Epidemiological study of lathyrism in Northwestern districts of Bangladesh.** Neuroepidemiology **15** (2):83-91 (author affiliation: Lambein F State Univ Ghent Physiol Chem Lab Kl Ledeganckstr 35 B-9000 Ghent BelgiumState Univ Ghent Physiol Chem Lab B-9000 Ghent BelgiumInst Postgrad Med & Res Dept Neurol Dhaka Bangladesh)
Two northwestern districts of Bangladesh with a population of 629,752 were surveyed from June 1991 to March 1993 to detect and follow up lathyrism patients. Out of 2,567 neurological patients, 882 were diagnosed as having lathyrism, giving a prevalence rate of 14.0/10,000. This prevalence was higher among young males: only 12.9% of the patients were female, and only 19.3% of the patients were over 30 years of age at onset of the disease. The average family size was 4.6 members. In the surveyed area, 730 families were evaluated: 622 families had only 1 affected member, and 108 families had 2-8 affected members. Most of the patients were working, while only 4% were not. The majority of the patients had a very low intake of animal protein. A few cases of human T-lymphotropic virus infection and osteolathyrism were found during this study. [References: 28].
Source: reprintDE
Animal Protein Intake/ Bangladesh lathyrism/ Lathyrism Epidemiology/ Human nutrition animal protein/ HTLV/ Osteolathyrism Bangladesh Osteolathyrism human/ Virology/ Osteolathyrism/ Age/ Bangladesh/ Epidemiology lathyrism/ Female/ Belgium/ Infection/ Intake/ Lathyrism Lathyrism animals/ Lathyrism Bangladesh/ Lathyrism nutrition/ Lathyrism viral infection/ Males/ Humans/ Nutrition animal/ Nutrition Population/ Prevalence/ Protein/ Reprint.

Ikonomidou, C.; Qin, Y. Q.; Labruyere, J., and Olney, J. W. (1996). **Motor neuron degeneration induced by excitotoxin agonists has features in common with those seen in the sod-1 transgenic mouse model of amyotrophic lateral sclerosis.** Journal of Neuropathology and Experimental Neurology **55** (2):211-224 (author affiliation: Olney Jw Washington Univ Sch Med Dept Psychiat 4940 Childrens Pl St Louis, Mo 63110 Usa)
A superoxide dismutase 1 (SOD-I) genetic defect has been identified in familial amyotrophic lateral sclerosis (ALS) and motor neuron degeneration has been described in SOD-1 transgenic mice. Because an excitotoxic mechanism has been implicated in ALS, we undertook studies to provide a description of excitotoxic degeneration of spinal motor neurons for comparison with the degenerative process observed in SOD-I transgenic mice. Excitotoxin agonists selective for each of the three major types of ionotropic glutamate receptors were applied directly onto the lumbar spinal cord of 21-day-old rats following posterior laminectomy. N-methyl-D-aspartate (NMDA) preferentially affected dorsal horn neurons, whereas the non-NMDA agonist, kainic acid, preferentially affected motor neurons. Cytopathological changes in motor neurons closely resembled those described in SOD-1 mice. These changes consist of massively swollen

dendritic processes in the presence of well-preserved presynaptic axon terminals; cell bodies of motor neurons tilled with vacuoles that originate both from endoplasmic reticulum and mitochondria; pleomorphic changes in mitochondria; axons of motor neurons becoming swollen proximally with accumulation of vacuoles, organelles, filaments, and degeneration products in the swollen segment. The observed changes in motor axons resemble changes described in the spinal cord of ALS patients. These findings are consistent with the proposal that motor neuron degeneration in ALS may be mediated by an excitotoxic process involving hyperactivation of non-NMDA glutamate receptors. [References: 55].
Source: Copyright Current Contents
AMPA/ Amyotrophic lateral sclerosis/ Dl-homocysteic acid/ Excitotoxicity/ Kainic acid/ Nmda/ Sod-1/ Rat spinal-cord/ Abnormal glutamate metabolism/ Amino-acids Parkinsonism-dementia/ Axonal swellings/ Cell-culture/ Kainic acid Brain/ Neurotoxicity/ Lathyrism.

Kusamaeguchi, K.; Ikegami, F.; Kusama, T.; Lambein, F., and Watanabe, K. (1996). **Effects of beta-ODAP and its biosynthetic precursor on the electrophysiological activity of cloned glutamate receptors.** Environmental Toxicology and Pharmacology **2** (4):339-342
3-N-Oxalyl-L-2,3-diaminopropanoic acid (beta-ODAP) induces neurolathyrism, a motor neuron disease. To elucidate the pathogenic mechanism of this process, the action of beta-ODAP on the excitatory amino acid (EAA) receptor-mediated currents was examined using cloned EAA receptors expressed in Xenopus oocytes. On the voltage-clamp recordings of an AMPA receptor(alpha(1)/alpha(2) heterooligomer), beta-ODAP was a strong agonist on this receptor, the potency being almost the same as L-glutamate. On the other hand, beta-ODAP had little effect on the glutamate-evoked currents through the expressed NMDA receptor (NR1(A) NR2A), but showed a weak inhibitory effect on the glycine-modulatory site. beta-ODAP may cause the neurodegenerative disease, neurolathyrism, mainly through the excitotoxic interaction with AMPA receptors. [References: 16].
Source: Reprinted with permission of the authors
AMPA receptor/ NMDA receptors/ Neurology/ ODAP/ Xenopus oocyte/ Neurolathyrism/ Lathyrus sativus toxicity/ Lathyrus sativus/ Toxicity Lathyrism.

Ludolph, A. C. and Spencer, P. S. (1996). **Toxic models of upper motor neuron disease.** Journal of the Neurological Sciences **139** (Suppl S):53-59 (author affiliation: Ludolph Ac Humboldt Univ Berlin Dept Neurol Schumannstr 20-21 D-10098 Berlin GermanyOregon Hlth Sci Univ Dept Neurol Portland, Or 97201 UsaOregon Hlth Sci Univ Ctr Res Occupat & Environm Toxicol Portland, Or 97201 Usa)
Although neurotoxic models for progressive degeneration of both the anterior horn cell and the Betz cell do not exist, (neuro)lathyrism and neurocassavism (konzo) are examples of self-limiting neurotoxic disorders that predominantly target the Betz cell. Both disorders are caused by the continuous intake of neurotoxic plant products (Lathyrus sativus and Manihot esculenta, respectively) which result in a virtually identical clinical picture of spastic paraparesis. A neurotoxic excitatory amino acid and AMPA agonist (beta-N-oxalylamino-L-alanine, BOAA) is held largely responsible for lathyrism. Epidemics of konzo are strongly associated with increased intake of the cyanide-liberating glycoside linamarin by protein-poor subjects. Whereas an animal model for neurocassavism does not exist, macaques fed Lathyrus sativus or BOAA develop central motor deficits with corticospinal tract involvement. Estimated dosages of Lathyrus sativus used to induce beginning lathyrism in well-nourished primates are 10-20 fold greater than those associated with irreversible human neurolathyrism. Major unexplained aspects of both diseases are the factors which allow the suspected toxins to target Betsz cells (blood-brain barrier, receptor distribution, cellular energy metabolism), the latency to onset in both diseases, and how two separate etiologic factors trigger clinically similar disorders. [References: 58].
Source: Copyright Current Contents
Motor neuron disease/ Neurolathyrism/ Neurocassavaism/ Konzo/ Free Radical/ ODAP/ Neurology/ Antinutritional factors/ Lathyrus sativus Beta Alanine analogs and derivatives/ Amino acids/ AMPA receptors/ Anterior horn/ Blood brain barrier/ Blood/ Brain/ Cyanides/ Energy Energy metabolism/ Excitatory amino acid/ Glycosides/ HCN/ Intake/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism chronic Cassava toxicity/ Lathyrism motor neurons/ Lathyrus toxicity/ Primates/ Humans/ Manihot esculenta/ Cassava/ Metabolism/ Models Motor neurons/ Neurons/ Neurotoxins/ Protein/ Receptors/ Spasticity/ Spastic paraparesis/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Toxin USA.

Reed, P. J.; Dickens, J. S. W., and Oneill, T. M. (1996). **Occurrence of anthracnose (Colletotrichum acutatum) on ornamental lupin in the united kingdom.** Plant Pathology **45** (2):245-248 (author affiliation: Reed Pj Maff Cent Sci Lab Hatching Green Harpenden Al5 2bd Herts EnglandAdas Hort Cambridge Cb2 2bl England)
The first recorded outbreak of anthracnose (Colletotrichum acutatum) on ornamental lupin in the United Kingdom occurred in 1989. Seedborne infection by Colletotrichum acutatum was investigated after seed was implicated in the origin of the outbreaks and infection was found on seed of three of 14 cultivars tested. In pathogenicity tests, typical anthracnose symptoms developed only on plants of Lupinus spp; there were slight

symptoms on Pisum sativum, Vicia sativa and Lathyrus odoratus, but none on Vicia faba, Phaseolus coccineus, P. vulgaris and Onobrychis viciaefolia. [References: 9].
Source: Copyright Current Contents
Lathyrus odoratus/ Anthracnose L. odoratus/ Colletotrichum acutatum host range/ Lathyrus odoratus/ Lathyrism symptoms/ Anthracnose/ Colletotrichum/ Cultivars/ England/ Fungi/ Mycology/ Hatching/ Horticulture/ Horticulture L. odoratus/ Hosts/ Host range/ Infection/ Lathyrism/ Lupinus/ Microbiology/ Onobrychis viciaefolia/ Ornamentals/ Ornamentals L. odoratus/ Pathogenicity/ Phaseolus/ Pisum sativum/ Seed/ Seed borne/ Symptoms lathyrism/ UK/ Vicia/ Vicia faba/ Vicia sativa.

Robertson, L. D.; Singh, K. B.; Erskine, W., and Abd El Moneim, A. M. (1996). **Useful genetic diversity in germplasm collections of food and forage legumes from West Asia and North Africa.** Genetic Resources and Crop Evolution **43** (5):447-460
The germplasm collections at ICARDA of faba bean, chickpea, lentil and forage legumes have been exploited by breeding programmes in the West Asia and North Africa region for production of improved cultivars. The first lines distributed were taken directly from the germplasm collections after initial evaluation. This formed the first flush of releases by national programmes, with 56 of 105 cultivars emanating from germplasm. A systematic evaluation of the food legumes for a wide range of morpho-agronomic characters based on the IBPGR/ICARDA descriptors has led to publication and widespread distribution of catalogues which, in turn, have led to an extensive use of the germplasm by national breeding programmes. In the period of 1990-1994, more than 5000 accessions of food legumes and more than 1900 accessions of forage legumes have been distributed per year. The most important use made of the germplasm collections has been their exploitation as a source for resistances and tolerances to biotic and abiotic stresses. These legumes often suffer severe yield loss due to disease and environmental stress; consequently, screening procedures were developed for the major biotic and abiotic stresses and were successfully applied in selecting sources of resistances and tolerances. The germplasm collections have also been used to improve the nutritional quality of these crops, both for human and animal consumption. Most of the food legume collections have been screened for protein content. The Lathyrus spp. collections have yielded lines with low levels of the neurotoxin ODAP (beta-N-Oxalyl-L-alpha,beta-Diaminopropionic Acid), which causes Lathyrism in humans and animals. These lines are being used extensively in the breeding programme. In addition to maintaining collections of the cultigens, ICARDA has also assembled large collections of wild relatives and progenitors of lentil and chickpea; and wild and weedy forms of the forage legume species. In the past five years the wild Lens and Cicer collections have been evaluated for resistances to biotic and abiotic stresses. These have been useful in providing sources of new, improved or multiple-stress resistance. They have also been useful in increasing yield potential and adaptation of the cultigens. [References: 71].
Source: reprintDE
Cicer arietinum/ Genetic resources collection/ Lathyrus spp Genetic resources/ Lens culinaris/ Vicia faba/ Vicia spp Genetic resources/ Genetic resources Lathyrus spp/ ODAP/ Forage/ Adaptation/ ICARDA/ Agriculture/ Genetic resources/ Africa/ Asia/ Cultivars/ Descriptors Distribution plants/ Environment/ Evaluation genetic resources/ Evolution/ Food/ Forage Syria/ Genetic diversity/ Genetic resources collecting Grain legumes/ Pulses/ Grain legumes evolution/ Grain legumes genetic resources/ Lathyrism animals/ Lathyrus spp/ Humans/ Neurotoxins North Africa/ Africa North/ Protein/ Protein content/ Quality/ Resistance/ Screening/ Stress/ Syria/ Syria genetic resources/ Vicia spp/ Vicia Weed/ Wild relatives/ Wild/ Yield/ Yield fodder/ Genetic resources evaluation/ Reprint.

Tiwari, K. R. and Campbell, C. G. (1996). **Inheritance of neurotoxin (ODAP) content, flower and seed coat colour in grass pea (Lathyrus sativus L).** Euphytica **91** (2):195-203 (author affiliation: Tiwari Kr Natl Grain Legume Res Program Rampur Chitawan NepalAgrifood Diversificat Res Ctr Morden Mb R6m 1y5 Canada)
A strong epidemiological association is known to exist between the consumption of grass pea and lathyrism. A neurotoxin, beta-N-Oxalyl-L-alpha, beta-diaminopropanoic acid (ODAP) has been identified as the causative principle. This study was undertaken to investigate the mode of inheritance of the neurotoxin ODAP, flower and seed coat colour in grass pea. Five grass pea lines with low to high ODAP concentration were inter-crossed in all possible combinations to study the inheritance of the neurotoxin. Parents, F-1 and F-2 progenies were evaluated under field condition and ODAP analyzed by an o-phthalaldehyde spectrophotometric method. Many of the progenies of low x low ODAP crosses were found to be low in ODAP concentration indicating the low ODAP lines shared some genes in common for seed ODAP content. The F-1 progenies of the low ODAP x high ODAP crosses were intermediate in ODAP concentration and the F-2 progenies segregated covering the entire parental range. This continuous variation, together with very close to normal distribution of the F-2 population both of low x low and low x high ODAP crosses indicated that ODAP content was quantitatively inherited. Reciprocal crosses, in some cases, produced different results indicating a maternal effect on ODAP concentration. Blue and white flower coloured lines of grass pea were inter-crossed to study the inheritance of flower colour. Blue flower colour was dominant over the white. The F-2 progenies segregated in a 13:3 ratio indicating involvement of two genes with inhibiting gene

interactions. The gene symbol LB for blue flower colour and LW for white flower colour is proposed. [References: 33].
Source: Reprinted with permission Copyright 1996 Kluwer Academic Publishers, Netherlands
Flower Colour/ ODAP inheritance/ Lathyrus sativus genetics/ Genetics L. sativus/ Breeding/ ODAP genetics/ Breeding ODAP/ ODAP inheritance/ Genetics ODAP/ Genetics L. sativus/ Lathyrus sativus genetics/ Genetics cytoplasmic factors/ ODAP biosynthesis cytoplasm Lathyrus sativus/ Biosynthesis/ Colour/ Flower colour genetics/ Flowers/ Genes/ Genetics/ Genetics flower colour/ Grain legumes/ Pulses Maternal/ Neurotoxins/ O phthalaldehyde/ ODAP/ ODAP biosynthesis/ Population/ Seed/ Seed coats.

Haque, A.; Hossain, M.; Lambein, F., and Bell, E. A. (1997). **Evidence of osteolathyrism among patients suffering from neurolathyrism in Bangladesh**. Natural Toxins **5** (1):43-46.
In a study of 500 patients suffering from neurolathyrism in Bangladesh it was found that 60 (all male) complained of bone pain and showed skeletal deformities suggestive of osteolathyrism. On X-ray examination a failure of fusion in both vertebral and iliac epiphyses was found in two patients. At the age of these patients (30 and 37 years) such failure was considered a clear evidence of osteolathyrism. All 60 patients were accustomed to eating the green parts of Lathyrus sativus, which contain 2-cyanoethyl-isoxazolin-5-one, a compound that chemically and metabolically can produce the osteolathyrogen beta-aminopropionitrile (BAPN), as well as foods made from the seeds of the same plant which contain the neurotoxin 3-N-oxalyl-2,3-diaminopropanoic acid (beta-ODAP).
Source: reprintDE
Lathyrus sativus/ Osteolathyrism/ Lathyrism/ Neurolathyrism/ Isoxazolin-5-one/ BAPN/ ODAP/ 2 Cyanoethylisoxazolin 5 one/ Isoxazolin-5-one toxicity/ NPAA 2-(2-cyanoethyl)-3-isoxazolin-5-one/ Bangladesh/ reprint.

Kusamaeguchi, K.; Kusama, T.; Ikegami, F.; Lambein, F., and Watanabe, K. (1997). **Inhibitory activity of a naturally occurring heterocyclic beta-substituted alanine, beta-(isoxazolin-5-on-4-yl)-l-alanine, on the l-glutamate/l-aspartate transporter (glast) expressed in xenopus oocytes.** Molecular Brain Research **52** (1):166-169 (author affiliation: Nihon Univ Coll Pharm Biol Lab Funabashi Chiba 274 Japan)
Excitatory amino acid (EAA) transporters are of physiological importance in the regulation of the extracellular concentration of excitatory amino acids and the neuroexcitation in CNS. Among four identified transporters, the Na+-dependent high-affinity L-glutamate/L-aspartate transporter (GLAST) is highly expressed in glial cells. Here, we report a naturally occurring inhibitor of GLAST, derived from bovine retina, using the Xenopus oocyte expression system. beta-(Isoxazolin-5-on-4-yl)-L-alanine (TAN), an antifungal antibiotic, inhibited [C-14]L-glutamate (L-Glu) transport into GLAST-expressing oocytes. TAN also served as a substrate for this transporter in voltage-clamp experiments measuring the current coupled to the EAA transport. The maximum current of TAN itself was approximate to 1/3 of that of L-glutamate, and its apparent affinity was almost the same as L-Glu. In combination with L-Glu, TAN antagonized L-glutamate transport. In radioisotope experiments, the inhibitory potency of this compound against [C-14]L-Glu uptake into oocytes was approximate to 1/6 of that of L-(-)-threo-3-hydroxyaspartate (THA). The glucoside of TAN (TANG), occurring in seedlings of the garden pea, the lentil and some Lathyrus species, did not show any electrophysiological activity nor was it transported into oocytes. It is proposed that TAN is a novel type antagonist of natural origin on GLAST. By affecting such transport system, naturally occurring compounds may affect the regulation of the extracellular level of endogenous EAA. (C) 1997 Elsevier Science B.V. [References: 18].
Glast/ Sodium-dependent transporter/ Oocyte/ Xenopus/ Neurolathyrism/ Lathyrus toxin/ Beta-(isoxazolin-5-on-4-yl)-l-alanine/ Beta-odap Rat-brain/ Functional-analysis/ Lathyrism/ Receptors Acid.

Melka, A.; Tekle Haimanot, R., and Lambein, F. (1997). **Symptomatic treatment of neurolathyrism with tolperizone HCl (mydocalm) - a randomized double blind and placebo controlled drug trial.** Ethiopian Medical Journal **35** (2):77-91
The efficacy and safety of oral Tolperisone HCL was evaluated in double blind, placebo-controlled, randomized trial in 72 patients with neurolathyrism in stages I, II, and III of the disease at Kolla Duba Health Centre of Dembia District of North Gondar between January and April 1995. Taken orally daily for 12 weeks, tolperisone: HCL (Mydocalm) in a dose of 150 milligrams (mgs) twice daily significantly improved subjective complaints such as muscle cramps,: heaviness of the legs, startle attacks, flexor spasms and repeated falls;, An overall subjective improvement was observed in 75% of the patients on tolperisone HCL and 39% of the placebo group (P=0.002). When-objectively assessed spastic muscle tone in the abductors, stiffness of Achilles and spontaneous ankle clonus were significantly reduced in tolperisone HCL group (P values = 0.001 0.04, and 0.0001, respectively). Walking ability and speed of walking was also significantly improved. The drug is most effective in relieving symptoms of stage I and stage II disease. Some adverse effects like muscle pain, generalized body-weakness and, dizziness were recorded in patients taking the drug but all were minor and self limited, none requiring discontinuation of treatment. It is concluded that tolperisone is a well tolerated and efficacious drug for symptomatic treatment of neurolathyrism. [References: 17].

Source: Reprinted with permission of the authors
Lathyrism/ Tolperisone/ Ethiopia/ Symptomatic treatment.

Padmajaprasad, V.; Kaladhar, M., and Bhat, R. V. (1997). **Thermal isomerisation of beta-n-oxalyl-l-alpha, beta-diaminopropionic acid, the neurotoxin in Lathyrus sativus, during cooking.** Food Chemistry **59** (1):77-80 (author affiliation: Indian Council Med Res Natl Inst Nutr Po Jamai Osmania Hyderabad 500007 Andhra Pradesh India Indian Council Med Res Natl Inst Nutr Hyderabad 500007 Andhra Pradesh India)
The naturally occurring beta-form of N-oxalyldiaminopropionic acid (beta-ODAP) present in Lathyrus sativus is the main neurotoxic principle implicated in neuro-lathyrism. The alpha-form of ODAP has been shown to be less toxic to experimental animals. Therefore, the extent of isomerisation of the toxin from the beta-form to the alpha-form during cooking might determine the toxicity of L. sativus seed. The results of the present study reveal that there is a temperature- and time-dependent isomerisation of the beta-form to the alpha-form. The extent of conversion of beta-ODAP to its alpha-form was determined in some common Indian cooking preparations and was found not to exceed 40%. It seems likely that the toxicity of L. sativus seed due to beta-ODAP is only partially removed during cooking and that a significant proportion of the toxin (about 60%) remains as the toxic beta-form. (C) 1997 Elsevier Science Ltd. All rights reserved. [References: 21].
ODAP isomerism/ Isomerism ODAP/ Lathyrus sativus processing/ Processing L. sativus.

Tekle Haimanot, R. and Lambein, F. (Eds) (1997). Lathyrus and Lathyrism. A decade of progress, in Addis Ababa, Ethiopia. Published in Ghent, Belgium: University of Ghent139 pp. ISBN: 90-803685-1-2.
Lathyrus sativus/ Lathyrus sativus review/ Review L. sativus/ Lathyrism/ Lathyrism review/ Review lathyrism.

Awasthi, S. and Boor, P. J. (1998). **Allylamine and beta-aminopropionitrile-induced vascular injury - enhanced expression of high-molecular-weight proteins.** Journal of Toxicology and Environmental Health **53** (1):61-76 (author affiliation: Boor Pj Univ Texas Med Branch Dept Pathol Chem Pathol Div Galveston, Tx 77555 Usa)
In the present study we describe changes in aorta at the protein level associated with allylamine (AA) and beta-aminopropionitrile (beta APN) induced vascular toxicity in a rat model. This model represents a remarkable synergistic, necrotizing toxic effect of these combined toxins, and our rationale was to examine protein expression in order to shed light on the mechanisms underlying this synergism. Rats were given AA (100 mg/kg body weight/day) and beta APN (1 g/kg body weight/day) by gavage for 10 d; this protocol has been shown to result in smooth-muscle necrosis, but no visible connective tissue changes. Soluble and insoluble fractions from AA + beta APN-or from beta APN-treated aorta showed enhanced expression of three high-molecular-weight protein bands (ranges between approximately 120 and 95 kD). The time course of induction of proteins showed the appearance of AA + beta APN-induced specific proteins at d 3 of AA + beta APN treatment. Partial purification and characterization suggested that AA + beta APN specific proteins are likely to be collagen proteins (type I). Thus, the data presented in this article help in understanding the vascular toxicity induced by AA + beta APN or by beta APN, in that we have described an altered phenotypic expression of collagenous proteins indicative of selective medial vascular toxicity. [References: 28].
Source: Copyright Current Contents
Smooth-muscle cells/ Sensitive amine oxidase/ Gel-electrophoresis Toxicity/ Collagen/ Rat/ Lathyrism/ Coronary/ Disease Invitro.

Bruel, A.; Ortoft, G., and Oxlund, H. (1998). **Inhibition of cross-links in collagen is associated with reduced stiffness of the aorta in young rats.** Atherosclerosis **140** (1):135-145 (author affiliation: Aarhus Univ Inst Anat Dept Connect Tissue Biol Dk-8000 Aarhus C Denmark)
Collagen and elastin fibres are of major importance in providing the aorta with tensile strength and elasticity. The presence of cross-links in collagen and elastin is essential for the mechanical stability of collagen and elastin fibres. beta-aminopropionitrile (BAPN) reduces the formation of cross-links by inhibiting the enzyme lysyloxidase. Young rats were injected with BAPN to inhibit the formation of cross-links, and the changes in the biomechanical and biochemical properties of the thoracic aorta were studied. The biomechanical analyses of aortic samples from BAPN-treated rats showed a significantly increased diameter (1.64 +/- 0.02 mm), a significantly reduced maximum load (1.08 +/- 0.08: N), and a significantly reduced maximum stiffness (3.34 +/- 0.10 N) compared with controls (1.57 +/- 0.02 mm, 1.55 +/- 0.04 N and 4.49 +/- 0.14 N, respectively). No changes in the concentrations of collagen and elastin were found. The content of pyridinoline? a mature collagen cross-link, was significantly decreased by 49% in the BAPN-treated group compared with controls. No changes in the concentration of desmosine+ isodesmosine, the major cross-links of elastin, were found. The present study shows that cross-links are essential in providing mechanical stability of the aorta. Even a partial inhibition of the cross-linking processes results in a destabilisation of the aortic wall with increased diameter and reduced strength and stiffness. (C) 1998 Elsevier Science Ireland Ltd. kll rights reserved. [References: 60].

Rat/ Lathyrism/ Aorta/ Biomechanics/ Collagen/ Elastin/ Pyridinoline/ Desmosines/ Performance liquid-chromatography Beta-aminopropionitrile/ Biomechanical properties/ Hydroxypyridinium crosslinks/ Mechanical-properties/ Coronary angioplasty/ Balloon angioplasty/ Hypertensive rats/ Marfan-syndrome Blood-pressure.

Getahun, H. and Tekle Haimanot, R. (1998). **Psychosocial assessment of lathyrism patients in rural Estie district of South Gondar, northern Ethiopia.** Ethiopian Medical Journal **36** (1):9-18 (author affiliation: Getahun H S Gondar Hlth Dept Pob 67 Debre Tabor Ethiopia)

Three hundred and thirty three patients in the lathyrism endemic rural Estie district of Northern Ethiopia were interviewed and examined to assess the psychosocial impacts of neurolathyrism. The majority of the affected were in the age group of 11-20 years (43%) followed by 21-30 years (29%). Males were more affected than females (4.8:1). Peak 1 occurrences of neurolathyrism was observed at time of mobilization of the population in villagization and land diversification schemes. Females were affected to lesser extent and at an earlier age than males. Neurolathyrism affected matrimony among the rural farming population where marriage is considered as the most significant social achievement of any young member of the society. Divorce rate due to paralysis was 28%. It also influenced the choice of occupation among the afflicted rural people. Many males went into ecclesiastical professions. A significant number of males also took up occupations which traditionally were considered to be exclusively for women like basketry and embroidery. More females, not withstanding their age, were engaged in cattle-keeping. During the study, the rural communities were made aware of the association of neurolathyrism and consumptions of grass pea seed. It is believed that this step will enable communities to use home-based detoxifying methods and resort to alternate crops during times of food shortage. [References: 11].

Source: Copyright Current Contents

Lathyrism/ Ethiopia/ Epidemiology.

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ODAP metabolism/ Lathyrism metabolism/ Lathyrism physiology/ Lathyrism biochemistry/ Lathyrus sativus/ India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism India/ Metabolism/ Neurotoxins/ ODAP/ Plant physiology.

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Source: ref ex Lal and Swarup (1989), reprintDE
Lathyrus sativus cultivation/ India L. sativus production/ Lathyrus sativus production/ Lathyrus sativus/ Cultivation/ India/ India L. sativus/ India Madhya Pradesh/ India L. sativus production/ India lathyrism/ Khesari/ Lathyrism/ Lathyrism India/ Lathyrism prevention/ Madhya Pradesh/ Prevention lathyrism/ Lathyrism prevention/ reprint.

Aall, C. (1976). **Report on lathyrism investigation, visit to Kustia district**. Dhaka: FAO/UNDP.
Source: ref ex Haque and Mannan (1989)
Lathyrism Bangladesh/ Bangladesh lathyrism/ FAO/ Bangladesh/ Lathyrism/ Reports.

Chowdhury, L. N. (1976) **Reactions of collagen and ground substance in experimental lathyrism in the rat.** [PhD thesis]: University of Illinois At Chicago, Health Sciences Center, 170 pp.
Osteolathyrism/ Dissertations/ Distribution plants/ Experimental lathyrism/ Lathyrism/ Lathyrism experimental/ Lathyrism France/ Lathyrism rats/ Rats/ Rodents.

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Source: Medline 77012095
History of Medicine 20th Cent/ Rats/ Wisconsin/ Lathyrism history/ Rodents/ History/ Lathyrism/ Lathyrism nutrition/ Lathyrism rats/ Nutrition Review.

Hirano, A.; Llena, J. F.; Streifler, M., and Cohn, D. F. (1976). **Anterior horn cell changes in a case of neurolathyrism.** Acta Neuropathol Berl **35** (4):277-283
Light and electron microscopic studies were made of the anterior horn cells in a case of neurolathyrism. Eosinophilic inclusions were observed at the light microscopic level. Fine structural study revealed the presence of two types of cytoplasmic inclusions. The first were aggregates of filaments, approximately 80-100 A in width, arranged in small bundles. The second were crystalloid structures composed of elongated elements, about 800 A wide, with hexagonal cross sections. The relationship to each other and the significance of these inclusions are unknown.
Source: Medline 76274380; Reprinted with permission Copyright 1976 Springer Verlag
Aged/ Cellular Inclusions ultrastructure/ Spinal Cord Diseases pathology/ Anterior Horn Cells ultrastructure/ Lathyrism pathology/ Motor Neurons ultrastructure/ Neurology/ Age/ Anterior horn/ Lathyrism/ Lathyrism Aged/ Motor neurons/ Neurolathyrism/ Neurons/ Spinal cord.

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Lathyrus sativus toxicity/ Lathyrism/ Lathyrus sativus/ Chemistry/ India/ India L. sativus/ India lathyrism/ Lathyrism India/ Lathyrus toxicity Poison/ Toxicity L. sativus/ Toxicity.

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Source: CGC_95_2
Lathyrism/ Lathyrus spp toxicity/ Chemistry/ Lathyrus spp/ Lathyrus toxicity/ Poison/ Toxicity Lathyrus spp/ Toxicity.

Schilling, E. D. and Strong, F. M. (1976). **Nutrition Classics. Journal of the American Chemical Society 76: 2848, 1954. Isolation, structure and synthesis of a Lathyrus factor from L. odoratus.** Nutrition Reviews **34** (8):242
Source: Medline 77012096
Beta aminopropionitrile isolation and purification/ Chemistry/ Glutamates/ Lathyrism history/ Lathyrus odoratus/ Beta aminopropionitrile Aminopropionitriles/ History/ Isolation/ Lathyrism/ Lathyrism nutrition/ Nutrition/ Purification/ Review/ BAPN.

Streifler, M.; Arlazoroff, A.; Kessler, A., and Cohn, D. F. (1976). **[The lower motor neuron in chronic neurolathyrism].** Harefuah **90** (10):479-480
Source: Medline 77004495
Lathyrism electromyography/ Lathyrism pathology/ Lathyrism complications/ Lathyrism motor Neurons/ Lathyrism paraplegia etiology Lathyrism spasm etiology/ Neurology/ Electromyography/ Lathyrism/ Lathyrism etiology/ Motor neurons/ Neurolathyrism/ Neurons/ Paraplegia Spasm/ Spasticity.

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Source: ref ex Tekle-Haimanot (1989)
Lathyrism Ethiopia/ Ethiopia lathyrism/ Ethiopia/ Lathyrism/ Rehabilitation/ Reports.

Cohn, D. F.; Streifler, M., and Schujman, E. (1977). **Das motorische Neuron im chronischen Lathyrismus. [The motor neuron in chronic neurolathyrism (author's transl).** Nervenarzt **48** (3):127-129
Source: Medline 77171469
Anterior Horn Cells pathology/ Chronic Disease/ Electromyography/ Leg innervation/ Lipofuscin/ Middle Age/ Motor Neurons pathology Muscular Atrophy etiology/ Muscular Atrophy physiopathology/ Neural Conduction/ Paralysis/ Lathyrism physiopathology/ Motor Neurons Neurology/ Age/ Anterior horn/ Lathyrism/ Lathyrism electromyography/ Lathyrism etiology/ Lathyrism motor neurons/ Lathyrism pathology Motor neurons/ Muscles/ Neural/ Neurolathyrism/ Neurons.

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Source: Medline 78128932
Adolescence/ Adult/ Aged/ Child/ Child Preschool/ India/ Lathyrism prevention and control/ Middle Age/ Lathyrism epidemiology/ Age Epidemiology lathyrism/ India lathyrism/ Lathyrism/ Lathyrism Adolescence/ Lathyrism Aged/ Lathyrism India/ Lathyrism prevention/ Humans Prevention lathyrism/ Lathyrism prevention.

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Source: Medline 78088661
Haplorhini/ Lathyrism chemically induced/ Rats/ Amino acids Diamino metabolism/ Brain metabolism/ Neurotoxins metabolism/ Plants Toxic Spinal Cord metabolism/ Synaptosomes metabolism/ Rodents/ Neurology/ Lathyrus sativus/ Synaptosomes/ Amino acids/ Brain/ Lathyrism Lathyrism rats/ Lathyrus toxicity/ Metabolism plant/ Neurotoxins/ Spinal cord/ Synapses/ Tissue/ Toxicity L. sativus/ Toxicity.

Streifler, M.; Cohn, D. F.; Hirano, A., and Schujman, E. (1977). **The central nervous system in a case of neurolathyrism.** Neurology **27** (12):1176-1178
We examined the central nervous system of a 67-year-old man who showed symptoms of lathyrism after being imprisoned at age 35 and fed on a diet of chick peas, Lathyrus sativus. The most obvious changes were loss of axons and myelin in the pyramidal tract in the lumbar spinal cord. These alterations correlated with spastic paraparesis. Other changes at the same level were a mild degree of degeneration of anterior horn cells. Pallor of Goll's tracts and axonal swelling in Goll's nuclei were also observed. A few examples of senile plaques and neurofibrillary tangles were observed in Ammon's horn.
Source: Medline 78051413
Lathyrism Aged/ Lathyrism hippocampus pathology/ Lathyrism etiology/ Lathyrism medulla oblongata pathology/ Lathyrism motor Neurons pathology/ Lathyrism nerve degeneration/ Lathyrism pyramidal tracts pathology/ Lathyrism central Nervous system pathology/ Lathyrism pathology/ Neurology/ Lathyrus sativus/ Axons/ Lathyrism symptoms/ Age/ Anterior horn/ Central Nervous system/ Chickens/ Diet Hippocampus/ Lathyrism/ Lathyrism hippocampus/ Humans/ Medulla/ Motor neurons/ Myelin/ Nerves/ Nervous system/ Neurolathyrism Neurons/ Nuclei/ Pyramidal tract/ Spasticity/ Spastic paraparesis/ Spinal cord/ Symptoms lathyrism.

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Source: reprintDE
Lathyrism India/ Lathyrism diagnosis/ Lathyrism therapy/ Lathyrism epidemiology/ Lathyrus sativus toxicity/ Lathyrus sativus/ Lathyrism symptoms/ Diagnosis/ Epidemiology lathyrism/ India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrus toxicity/ Symptoms lathyrism Toxicity L. sativus/ Toxicity/ reprint.

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Source: Medline 79053352
Aged/ Chronic Disease/ Middle Age/ Paralysis immunology/ HLA Antigens/ Lathyrism immunology/ Muscle Spasticity immunology Neurology/ Age/ Antigens/ HLA/ Immunology/ India/ India lathyrism/ Lathyrism/ Lathyrism Aged/ Lathyrism India/ Muscles/ Muscle spasticity/ Neurolathyrism/ Paralysis/ Spasticity.

Deshmukh, P. and Taylor, J. J. (1978). **Neurofibrillary tangles in experimental neurolathyrism in rats induced by imino dipropionitrile (IDPN). 1. Fine structural changes in the spinal cord and dorsal root ganglia.** Acta Neuropathol Berl **41** (1):17-22
Anterior horns of the spinal cord from cervical and lumbar regions and dorsal root ganglia from these same levels were studied for ultrastructural changes in imino-dipropionitrile (IDPN) treated rats. Normal saline-injected rats, treated identically, served as controls for this study. In the spinal cord axonal balloons or dystrophic axons appeared in lightly myelinated or unmyelinated axons within 24 h after the third injection of IDPN. At this time hind leg paralysis had not yet developed. In addition to axonal changes, a few dendrites also showed neurofibrillary degeneration. Central chromatolytic changes were observed in most of the neurons, with evidence of generalised oedema present within the cord. In the dorsal root ganglia axonal balloons were very prominent and showed neurofibrillary hypertrophy. Neurofibrillary material was also noted in the perikarya of medium-sized ganglion cells.
Source: Medline 78141459; Reprinted with permission Copyright 1978 Springer Verlag
Dendrites/ Edema/ Hypertrophy/ Lathyrism etiology/ Microscopy Electron/ Nervous system diseases chemically induced/ Neurofibrils/ Nitriles Rats/ Time Factors/ Ganglia Spinal pathology/ Lathyrism pathology/ Nervous system diseases pathology/ Spinal Cord pathology/ Rodents Neurology/ Axons/ Ganglia/ Injections/ Lathyrism/ Lathyrism rats/ Microscopy/ Nervous system/ Neurolathyrism/ Neurons/ Oedema/ Paralysis Roots/ Spinal cord/ Nervous system diseases.

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Ethiopia lathyrism/ Lathyrism Ethiopia/ Neurology/ Ethiopia/ Lathyrism/ Lathyrism review/ Neurolathyrism/ Reports/ Review.

Hamilton, D. (1978). **Some experience with paraplegia in a small hospital in Nepal.** Paraplegia **15** (4):293-301
Paraplegia is a common problem in developing countries. They are the most pitiable group of cases seen, but they can all be offered some help, however limited one's resources. The main causes are Potts Disease, arachnoiditis, tropical spastic paraplegia, trauma, lathyrism and cord compression. The usual trauma is falling from trees and the use of trained monkeys to gather leaves and nuts whilst humorous should not be dismissed. The author saw some 35 cases of paraplegia, of which four are described--two good results and two bad. The physician going to a developing country is advised to prepare himself for the care of these cases and to be prepared to motivate staff, patients and relatives. He will find local medical assistants are kind and enthusiastic and rapidly acquire the necessary skills. Nearly all cases should receive a simple and inexpensive anti-tuberculous regime, vitamins and a very generous diet. Necessary equipment required for the home should be locally made and nothing requiring more than simple maintenance should be used.
Source: Medline 78115080; Reprinted with permission. Copyright (1978) Stockton Press
Adult/ Child/ Nepal/ Paraplegia etiology/ Paraplegia therapy/ Diet/ Lathyrism/ Lathyrism etiology/ Lathyrism therapy/ Leaves/ Humans Paraplegia/ Primates/ Spasticity/ Spastic paraplegia/ Tropics/ Vitamins.

López Aydillo, N. R. and Ramirez Gomez, C. (1978). **II. Probable etiologia de la alopecia en los enfermos latiricos espanoles. Resultado de la investigacion de toxinas en los hongos que se desarrollan en la superficie externa de las semillas del 'Lathyrus sativus' (almortas). [II. Probable etiology of alopecia in the Spanish lathyric patients. Results of study of toxins in fungi that develop in the external surface of the seeds of Lathyrus sativus].** Arch. Neurobiol. Madr **41** (6):461-486
Source: Medline 79081526, reprintDE
Aflatoxins analysis L. sativus/ Microbiology L. sativus/ Legumes toxins/ Mice/ Penicillium isolation and purification/ Pruritus chemically induced/ Seed/ Alopecia chemically induced/ Food Contamination mycotoxins/ Lathyrism complications/ Spain lathyrism/ Lathyrism Spain Rodents/ Antinutritional factors/ Lathyrus sativus/ Mycotoxins/ Aflatoxins/ Alopecia/ Contamination/ Food contamination/ Food/ Fungi Mycology/ Isolation/ Lathyrism/ Lathyrism etiology/ Lathyrism mycotoxins/ Microbiology/ Penicillium/ Purification/ Spain/ Spain L. sativus Toxin/ reprint.

Ramachandran, L. K. (1978). **Lathyrus: The sinister seed**. Scientific Reports of the Indian Agricultural Research Institute **15**:99-.
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Lathyrus sativus toxicity/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Agriculture/ Toxicity/ India/ India L. sativus/ Lathyrism/ Lathyrus toxicity/ Reports/ Seed/ Toxicity L. sativus.

Somogyi, J. C. (1978). **Natural toxic substances in food.** World Review of Nutrition and Dietetics **29**:42-59
Source: Medline 78206461
Cinnamates pharmacology/ Favism etiology/ Lathyrism etiology/ Phenols pharmacology/ Thiamine antagonists and inhibitors/ Toxin analysis Food Analysis/ Antinutritional factors/ Favism/ Food/ Lathyrism/ Lathyrism nutrition/ Lathyrism review/ Nutrition/ Phenols/ Review/ Thiamine Toxic substances/ Toxin.

Culebras, A. (1979). **Chick peas and neurolathyrism [letter].** Neurology **29** (3):424
Source: Medline 79200072
Lathyrism etiology/ Legumes poisoning/ Neurology/ Chickens/ Lathyrism/ Neurolathyrism.

Liener, I. E. (1979). **Significance for humans of biologically active factors in soybeans and other food legumes.** Journal of the American Oil Chemist's Society **56** (3):121-129
Source: Medline 80138242
Biological Availability/ Cyanides/ Dietary Proteins/ Favism etiology/ Lathyrism etiology/ Lectin/ Plants Toxic/ Thyroid Antagonists/ Legumes Nutrition/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Diet/ Favism/ Food/ Glycine max/ HCN/ Dietary/ Lathyrism/ Lathyrism nutrition/ Humans/ Protein.

Mehta, T.; Zarghami, N. S.; Parker, A. J.; Cusick, P. K., and Haskell, B. E. (1979). **Neurotoxicity of orally or intraperitoneally administered L-3-oxalyamino-2-aminopropionic acid in the mouse**. Toxicology and Applied Pharmacology **48**:1-9
ODAP oral toxicity/ Bioassay mouse/ Rodents/ ODAP intraperitoneal toxicity/ Lathyrism ODAP toxicity/ Neurology/ Bioassay/ Lathyrism Lathyrism Bioassay/ Mice/ Neurotoxicity/ ODAP/ Toxicity ODAP/ Toxicity rodents bioassay/ Toxicity.

Bhat, R. V. and Krishnamachari, K. A. V. R. (1980). **Social management of lathyrism and venoocclusive disease in Madhya Pradesh**. Hyderabad, India: Food and Drug Toxicology Research Centre.
Source: ref ex Kaul et al. (1989)
Lathyrism prevention/ Lathyrism India/ India lathyrism/ Lathyrism socioeconomics/ Socioeconomics lathyrism/ Economics/ Drugs/ Food/ India India Madhya Pradesh/ Lathyrism/ Lathyrism economics/ Madhya Pradesh/ Management/ Prevention lathyrism.

Bhuiyan, A. Q. and Sarker, P. C. (1980). **Socio-economic conditions of lathyrism-affected families in Rajshashi and Kushtia districts**. Rajshahi: Shaw Unnayan.
Source: ref ex Kaul et al. (1989); NAL Call No RA1242 L35B48 1980
Lathyrism socioeconomics/ Socioeconomics lathyrism/ Bangladesh lathyrism/ Lathyrism Bangladesh/ Economics/ Bangladesh/ Lathyrism Lathyrism economics.

Borg, J.; Bakri, S., and Mazars, G. (1980). **A propos de la neurotoxicité de *Lathyrus sativus* L., plante alimentaire et médicinale de l'Inde**. Actes du Colloque sur les médicines traditionelles de l'Asie, in Paris. Published in Strasbourg.
Source: Grmek (1980)
Lathyrism/ Lathyrism India/ India lathyrism/ History lathyrism/ Lathyrism history/ Lathyrus sativus/ Medicinal properties/ Tradtional medicine.

Grmek, M. D. (1980). **La légende et la réalité de la nocivité des fèves [Legend and reality in relation to the toxicity of Vicia faba].** Pubbl. Stn. Zool. Napoli. II **2** (1):61-121 (author affiliation: Ëcole Partique de Hautes Etudes, 22, rue des Ëcoles, 75005 Paris, France)
[French] This paper reviews in detail the classical, historical, esoteric and scientific literature related to Favism and the Pythagoraean ban on Vicia faba (kúamon apéchesthai - abstine from faba beans). It is an excellent source of citations. On pp. 80-87 a section titled "Aveuglement prudent des médicins et constat hippocratique du lathyrisme" lathyrism is discussed. P. 83 Citation of a passage from Hippocrates Epidemics [epédemies, livre II, répété dans livre VI; book II, repated in Book IV] A Ainos, lors d'une famine, ceux qui mangeainet continuellement des légumineuses devinrent impotens des membres inférieurs; cela persista; de plus, ceux qui mangeaient de l'ers eurent douleur aux genoux [Epid. II 4,3 (Littré V 126) et Epid. VI 4, 11 (Littré V 310) ; translation differs sensibly from that of Littré]. Translated into English this reads: During famine at Ainos those who continuously ate legumes developed impotence of the lower limbs. This persisted. Others, who ate Vicia ervilia suffered pain in their knees." Ainos was a village in Thrace, the epidemic [dated to the last decade of the 5th century B.C. or first part of 4th century ; Grmek, M.D. (1980) La description hippocratique de la toux épidémique de Périnthe. Hippocratica, Paris pp. 199-221 [particularly pp.211-216]] was associated with war and economic deterioration [May, J.M.F (1950) Ainos, its history and coinage, Oxford, Oxford University Press]. Two terms are used in the greek text. Orobophagéontes and

ospriophagéontes [Orobos eaters, ospria eaters]. Galen in his commentary of Hippocrates [Galen, In Hippocratis libros I et II Epidemiarum commentaria. ; the famine in Ainos is not known in arabic translations, see Wenkebach, E. and Pfaff, F. (1934) Corpus Medicorum Graecorum V 10, 1, Leizpig and Berlin, Teubner] interpreted ospria as legumes which are not habitually used for the preparation of bread. Orobos = Vicia ervilia Willd. [used by Theophasrus and Dioscorides]. The symptom of knee pain is too general to allow any valuable conclusions regarding its etiology. A definite paraplegia following the ingestion of legumes, however, can be attributed retrospectively to the consumption of Lathyrus spp. [L. sativus, L. cicera, [D.E. addendum L. clymenum]. The use of Lathyrus sativus as food in the graeco-roman world (André, 1961, p.38) is also attested by the comic poets [Anaxandrides, frgm. 41, 43; Alexis, frgm. 162, 12].
Source: reprintDE_2001
Greece/ History of Medicine/ Ancient History/ Human/ Rome/ Favism/ Legumes/ adverse/ effects/ Vicia/ V. faba/ Lathyrism/ Vicia ervilia Lathyrus sativus/ Dioscorides/ Hippocrates.

Gupta, Y. P. (1980). **Khesari Dal consumption- A health hazard**. Indian Farming, Vol. 30, pp. 7-9.
Lathyrus sativus toxicity/ Lathyrism India/ India lathyrism/ Lathyrus sativus human consumption/ Human consumption L. sativus/ Lathyrus sativus/ Dhal/ Human consumption/ India/ India L. sativus/ India L. sativus consumption/ Khesari/ Lathyrism/ Lathyrus toxicity/ Humans Toxicity L. sativus/ Toxicity.

Librach, I. M. (1980). **Lathyrism.** Br J Clin Pract **43** (4):118-120
Source: Medline 80242455
Middle Age/ Paraplegia etiology/ Lathyrism complications/ Age/ Lathyrism/ Lathyrism etiology/ Paraplegia.

Padmanaban, G. (1980). **Lathyrogens**. [Chap 8 in] Liener, I. E. (Ed). **Toxic constituents of Plant foodstuffs**, 2nd. edn. ed., N.Y.: Academic Press, pp. 239-261.
Source: reprintDE
Lathyrus sativus toxicity/ Lathyrism review/ NPAA review/ Legume toxins/ Review/ Antinutritional factors/ Lathyrus sativus/ Lathyrism Lathyrogens/ Lathyrus toxicity/ NPAA/ Toxicity L. sativus/ Toxicity/ Toxin/ reprint.

Schneider, G.; Ruther, W.; Klapproth, A., and Schott, K. J. (1980). **Untersuchungen ueber die Wirkung der 'neurolathyrogenen' Substanz beta,beta'-Iminodipropionitril auf den Salzkrebs Artermia salina. [Studies on the effect of the neurolathyrogenic substance beta,betaiminodipropionitrile on the branchiopod Artemia salina].** Arzneimittelforschung **30** (4):592-593
beta,beta'-Iminodipropionitrile (IDPN) is a neurotoxic substance, which induces choreiform movements for life in rats and mice. As for the phenotype this seems to be a suitable animal model for the comparison with Huntington's chorea in man. In our experiments we have tested the effect of IDPN on different developmental stages of the branchiopode Artemia salina. One-day old nauplii show the strongest reaction to the substance. As little as 10(-5) g IDPN/l culture medium induces in one-day old nauplii a characteristically altered swimming behaviour. This behavioural response of the one-day old nauplii may possibly serve as a basis for a simple qualitative biological assay for the detection of IDPN or its effective metabolite, respectively.
Source: Medline 80242171
Aging/ Behaviour Animal drug effects/ Chemistry/ Mice/ Rabbits/ Swimming/ Artemia salina drug effects/ Lathyrism chemically induced Nervous system drug effects/ Nitriles pharmacology/ Rodents/ Bioassay nauplii swimming behaviour (Artemia salina)/ Neurology/ Bioassay Chorea/ Drugs/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bioassay/ Lathyrism rats/ Humans/ Models/ Nervous system/ Neurotoxins/ Nitriles/ Rats.

Sharma, N. K.; Jain, M. K.; Khanijo, S. K., and Choudhary, R. N. (1980). **A study of paraplegia. Lathyrism. Clinal profile (Thesis)**. Rewa: University of Rewa.
Lathyrism symptoms/ Lathyrism India/ Lathyrism symptoms/ India/ India lathyrism/ Lathyrism/ Paraplegia/ Symptoms lathyrism.

Weintroub, S.; Cohn, D. F.; Salama, R.; Streifler, M., and Weissman, S. L. (1980). **Skeletal findings in human neurolathyrism. Is there a human osteolathyrism?** European Neurology **19** (2):121-127
In a review of the roentgenological files of 22 patients suffering from spastic paraplegia due to neurolathyrism, 3 patients were found to present abnormal skeletal findings. 2 patients showed absence of union of the secondary ossification centres of the iliac crests, the ischial tuberosities and the vertebral bodies. Their age at the time of ingestion of poisonous Lathyrus sativus plants was 19 and 20 years. The 3rd patient had bowing and thickening of his right femoral shaft. He was 22 years old at the time of poisoning. These findings which are similar to those found in experimental osteolathyrism have never been described in clinical neurolathyrism. They are of a nature to throw some doubt on the correctness of the currently prevailing concept of sharp distinction between these two pathological entities.
Source: Medline 80224764; Reprinted with permission Copyright 1980 S Karger AG, Basel, Switzerland
Lathyrism complications/ Lathyrism radiography/ Lathyrism/ Neurology/ Lathyrus sativus/ Osteolathyrism/ Age/ Bones/ Lathyrism review Lathyrism skeletal/ Humans/ Neurolathyrism/ Paraplegia/ Review/ Skeletal/ Spasticity/ Spastic paraplegia/ Switzerland.

Ahmad, K. and Jahan, K. (1981). **Studies of neurolathyrism**. **First national seminar on lathyrism**, Dhaka.
Source: ref ex Haque and Mannan (1989)
Lathyrism Bangladesh/ Bangladesh lathyrism/ Neurology/ Bangladesh/ Lathyrism/ Neurolathyrism.

Anonymous (1981). First National Seminar on Lathyrism., in Dhaka University. Published in unpublished.
Lathyrism/ Lathyrus/ Bangladesh/ Food/ Lathyrism Bangladesh/ Lathyrism nutrition/ Nutrition.

Bhuiyan, A. Q. (1981). **Lathyrism in Bangladesh: A study of the victim families**. **First national seminar on lathyrism**, Dhaka.
Source: ref ex Haque and Mannan (1989)
Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrism socioeconomics/ Bangladesh/ Lathyrism.

Cohn, D. F. and Streifler, M. (1981). **Human neurolathyrism, a follow up study of 200 patients. Part I: Clinical investigation.** Schweiz Arch Neurol Neurochir Psychiatr **128** (1):151-156
Two hundred patients with chronic neurolathyrism were clinically examined, 25 to 35 years after exposure to the Lathyrus sativus pea. All the patients were prisoners in a labour camp under similar nutritional and physical conditions at the outbreak of the syndrome. The main symptoms were spastic paraparesis and a neurogenic bladder, both of varying degree. In addition lower motor neuron involvement with muscular atrophies was noticed in 14 cases and simulated amyotrophic lateral sclerosis. A lathyric sensory neuropathy was found in 12 patients. No cranial lesions or psychiatric disorders were found. Laboratory tests including 5 CSF specimens were normal. HLA typing was unremarkable. Our overall impression was that chronic neurolathyrism in the long run shows a gradually slow progressive course.
Source: Medline 81225713
Adult/ Aged/ Follow Up Studies/ Legumes/ Middle Age/ Muscle Spasticity diagnosis/ Nervous system diseases diagnosis/ Neuromuscular Diseases diagnosis/ Paralysis diagnosis/ Sensation/ Lathyrism diagnosis/ Neurology/ Lathyrus sativus/ Lathyrism symptoms/ Syndrome/ Age Amyotrophic lateral sclerosis/ cAMP/ Diagnosis/ HLA/ Lathyrism/ Lathyrism Aged/ Lathyrism motor neurons/ Humans/ Motor neurons Muscles/ Muscle spasticity/ Nervous system/ Neurolathyrism/ Neuromuscular/ Neurons/ Paralysis/ Physical/ Spasticity/ Spastic paraparesis Switzerland/ Symptoms lathyrism/ Nervous system diseases.

Cohn, D. F. and Streifler, M. (1981). **Human neurolathyrism, a follow up study. Part II: Special investigations.** Schweiz Arch Neurol Neurochir Psychiatr **128** (1):157-163
Special investigations were undertaken in the group of patients suffering from chronic neurolathyrism as described in part one of our work. X-ray films of the skeleton were taken of 45 patients. Pathologic findings similar to experimental osteolathyrism were revealed in 5 patients. These observations have not been described before. Sural nerve biopsies were taken from three patients with lathyric sensory neuropathy. Electron microscopy revealed mainly thick myelin sheaths which extended into the axonal regions. The picture is similar to the 'tomaculous' neuropathy of Bradley. The lower motor neuron was involved in a few cases, manifested by delayed nerve conduction time and muscular atrophies.
Source: Medline 81225714
Adolescence/ Adult/ Bone Diseases diagnosis/ Follow Up Studies/ Legumes/ Motor Neurons physiology/ Nervous system diseases diagnosis Neuromuscular Diseases diagnosis/ Sensation/ Lathyrism diagnosis/ Neurology/ Osteolathyrism/ Bones/ Diagnosis/ Lathyrism/ Lathyrism Adolescence/ Lathyrism motor neurons/ Humans/ Microscopy/ Motor neurons/ Muscles/ Myelin/ Nerves/ Nervous system/ Neurolathyrism Neuromuscular/ Neurons/ Physiology not plant/ Skeletal/ Switzerland/ Nervous system diseases.

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Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ Neurology/ Lathyrism/ Paraplegia/ Spinal cord/ Syndrome.

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Lathyrus sativus cultivation/ Lathyrism Bangladesh/ Lathyrus sativus/ Bangladesh/ Cultivation/ Grain legumes/ Pulses/ Grain legumes Bangladesh/ Khesari/ Lathyrism.

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NPAA toxicity/ Isoxazolin-5-one toxicity/ Bioassay poultry/ Poultry bioassay/ Seedling/ Lathyrus odoratus/ Bioassay/ Isoxazolin-5-one Agriculture/ Chemistry/ Belgium/ Lathyrism/ Lathyrism Bioassay/ Lathyrus toxicity/ NPAA/ NPAA chemistry/ Poultry/ Seedling chemistry Seedling NPAA/ Toxicity L. odoratus/ Toxicity.

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Pearson, S. and Nunn, P. B. (1981). **The neurolathyrogen, beta-N-oxalyl-L-alpha,beta-diaminopropionic acid, is a potent agonist at 'glutamate preferring' receptors in the frog spinal cord.** Brain Research **206** (1):178-82
A neurotoxic amino acid, beta-N-oxalyl-L-alpha,beta-diaminopropionate (beta-ODAP), found in seeds of Lathyrus sativus and a possible causative agent of neurolathyrism, was equipotent with kainate as a depolarizing agent of frog spinal cord ventral roots. beta-ODAP and kainate appeared to act on a common receptor, as their actions could not be differentiated pharmacologically. These results could explain some of the symptoms of neurolathyrism.
Source: Medline 81135095; Reprinted with permission Copyright 1981 Elsevier Science B.V., Amsterdam, Netherlands
Kainic Acid pharmacology/ Rana pipiens/ Rana temporaria/ Receptors Endogenous Substances drug effects/ Spinal Cord drug effects/ Amino acids Diamino pharmacology/ Receptors Endogenous Substances physiology/ Spinal Cord physiology/ ODAP/ Neurology/ Lathyrus sativus Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Lathyrism symptoms/ Amino acids/ Brain/ Drugs/ Endogenous/ Glutamates/ Kainic acid/ Lathyrism/ Lathyrism Bioassay/ Neurolathyrism/ Neurotoxins/ Physiology not plant/ Receptors/ Reptiles/ Roots/ Seed/ Spinal cord Symptoms lathyrism.

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Source: Agricola (79-84) IND 82049554
Lathyrism pathology/ Lathyrism central Nervous system pathology/ Neurolathyrism/ Forced labor camp/ Toxicity/ Neurology/ Lathyrus sativus cAMP/ Central Nervous system/ Lathyrism/ Lathyrus toxicity/ Nervous system/ Toxicity L. sativus.

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Source: Agricola (79-84) IND 82114085
Lathyrus sativus India/ India L. sativus/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Delhi/ Food/ Geography/ India/ Lathyrism Humans/ Paraplegia/ Protein/ Seed/ Spasticity/ Spastic paraplegia.

Ahmad, K. and Jahan, K. (1982). **Neurolathyrism and L-ascorbic acid.** Food and Nutrition Bulletin **4** (4):missing in online article (author affiliation: Kamaluddin Ahmad and Khursheed Jahan; Institute of Nutrition and Food Science, University of Dacca, Dacca, Bangladesh)
Neurolathyrism is a disease that has crippled many thousands in the Indian subcontinent and elsewhere during the past several centuries (1). It struck poor people who used the seeds of Lathyrus sativus as the principal item in their diet continuously for a period of at least two to three months. The disease appeared to affect humans almost exclusively. No experimental animal model was available to facilitate biomedical research on the subject until recently, when we produced the condition in guinea pigs (2). When guinea pigs having a subacute deficiency of L-ascorbic acid were fed for four to five weeks on a diet of cooked L. sativus seeds supplemented with minerals and the usual vitamins except for L- ascorbic acid, they developed typical symptoms of neurolathyrism, affecting the hind limbs. The same condition also appeared within two to three hours following intraperitoneal administration of an extract of L. sativus (3) in guinea pigs previously made deficient in ascorbic acid by omitting it from a normal diet that did not include any L. sativus seeds. We further found that L-ascorbic acid not only protected the animals from the neurotoxic effect of L. sativus, but also had a curative effect on those that had earlier become paralysed by the toxicity of the seeds. We subsequently produced the same symptoms of neurolathyrism in monkeys made deficient in ascorbic acid by feeding them cooked L. sativus seeds or by administering extracts of L sativus intraperitoneally. Thus, a subacute deficiency of L-ascorbic acid that was not severe enough to produce scorbutic symptoms was found to be a precondition for the appearance of neurolathyrism attributed to L. sativus seeds. This also explained the failure to produce experimental neurolathyrism in laboratory animals that do not require any dietary supply of L-ascorbic acid or that were provided this vitamin in the experimental diet before we suspected that its

deficiency could be a predisposing factor. Finally, a neurotoxin, ß-N-oxalyl L -a, ß-diamino propionic acid (ODAP), isolated from L. sativus seeds (4), was administered intraperitoneally in two-day-old chicks. It produced neurological symptoms such as retraction of the head and paralysis of the legs, indicating damage to the central nervous system. REFERENCES: 1. S. L.N. Rao, K. Malathi, and P.S. Sarma, World Review of Nutrition and Dietetics, 10: 214 (Karger, Basel, New York, 19691; 2. K. Ahmad and K. Jahan, The Third Asian Congress of Nutrition, Jakarta, Indonesia, 6-10 Oct. 1980, p. 190; 3. V, Nagarajan and C. Gopalan, "Production of Neurolathyrism in Chicks by Injection of Lathyrus sativus Concentrates," Current Sci, 32: 116(1963h); 4. S.L.N Rao, P.R. Adiga, and P.S. Sarma, "Isolation and Characterisation of ß-N-oxalyl L a, ß-diamino Propionic Acid, a Neurotoxin from Seeds of Lathyrus sativus," Biochem., 3: 432 (1964).
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Source: ref ex Kaul et al. (1989)
Lathyrism prevention/ Lathyrus sativus replacement/ Lathyrus sativus/ Agriculture/ Khesari/ Lathyrism/ Prevention lathyrism.

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One hundred and seventy two cultivars of Khesari (Lathyrus sativus L) were analysed for the lathyrism causing toxin, namely, B-N-oxylyl-L-L-B-diamino propionic acid (BOAA). Three cultivars having significantly lower toxin content were identified. No association was found between any of the agronomic or morphological character. BOAA content was not correlated with protein content in the grain. Low toxin content of lines was found to be suitable under varied environmental conditions.
Source: reprintDE
NPAA/ Screening/ Agronomy/ Bangladesh/ ODAP/ Lathyrus sativus/ Agriculture/ Genetic resources/ Cultivars/ Environmental variation ODAP/ Environment/ Khesari/ Lathyrism Bangladesh/ Lathyrus sativus agronomy/ Neurotoxins/ Protein/ Protein content/ Toxin/ reprint.

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Source: CGC_95_2
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date is estimated.
Lathyrus sativus India/ India L sativus/ Lathyrism review/ Lathyrus sativus/ Constraints/ Delhi/ Grain legumes/ Pulses/ Grain legumes India/ India/ India L. sativus production/ India lathyrism/ Lathyrism/ Lathyrism India/ Review.

Cohn, D. F. and Streifler, M. (1983). **Intoxication by the chickling pea (Lathyrus sativus): nervous system and skeletal findings.** Arch Toxicol Supplement **6**:190-193
Two hundred patients with chronic neurolathyrism were examined 25-35 years after the appearance of signs and symptoms of intoxication of the chickling pea. Their daily food intake, in a German forced labor camp during World War II, consisted of 400 g Lathyrus sativus peas cooked in water plus 200 g bread baked of barley and straw. Apart from the classic signs of neurolathyrism, i.e., a spastic paraparesis, in five cases, the skeletal findings observed were similar to experimental osteolathyrism. There was an absence of ossification centers of the iliac creasts, ischial tuberosities and vertebrae; and bowing with thickening of the femoral shaft also occurred. These bony changes in human lathyrism have not been described before.
Source: Medline 84023104; Reprinted with permission Copyright 1983 Springer Verlag
Adolescence/ Adult/ Bone Diseases radiography/ Follow Up Studies/ Middle Age/ Osteogenesis/ Bone Diseases etiology/ Lathyrism physiopathology/ Nervous system diseases etiology/ Neurology/ Lathyrus sativus/ Osteolathyrism/ Straw/ Agriculture/ Lathyrism symptoms Age/ Hordeum/ Bones/ Bread/ cAMP/ Food/ Forced labor camp/ Germany/ Intake/ Lathyrism/ Lathyrism Adolescence/ Lathyrism etiology Lathyrism radiography/ Lathyrism skeletal/ Lathyrus toxicity/ Humans/ Nervous system/ Neurolathyrism/ Skeletal/ Spasticity/ Spastic paraparesis/ Symptoms lathyrism/ Toxicity Osteolathyrism/ Toxicity L. sativus/ Toxicity/ Water/ Nervous system diseases.

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Lathyrism prevention/ Prevention lathyrism/ Lathyrus sativus toxicity/ Lathyrism vitamin C/ Vitamin C lathyrism/ Malnutrition Vit C/ Famine Malnutrition/ Lathyrus sativus/ Ascorbic acid/ Vitamin C/ Bangladesh/ Lathyrism/ Lathyrism Bangladesh/ Lathyrus toxicity/ Toxicity L. sativus Toxicity/ Vitamins.

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Source: ref ex Lal and Swarup (1989)
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Liener, I. E. (1983). **Naturally occurring toxicants in foods and their significance in the human diet.** Arch Toxicol Supplement **6**:153-166
Among the many biologically active and potentially toxic factors known to be present in plant foodstuffs normally consumed by man, those that are present in legumes have received the most attention. Two categories of legume toxins will be considered - those whose effects have been extensively studied in experimental animals but whose significance in man must remain open to conjecture, and those which are known to produce toxic effects in man but whose identity remains uncertain because similar effects are not readily reproduced in animal models. The protease inhibitors have, over the years, been the object of much study in experimental animals where they have been observed to have an adverse effect on growth and to cause pancreatic enlargement. The relevance of these observations to human nutrition remains obscure, however, because of our lack of knowledge concerning the effect of soybean trypsin inhibitors on the human pancreas. Lectins from certain legumes such as the common bean (Phaseolus vulgaris) have been shown to be toxic to animals upon oral ingestion presumably because of the damage which they inflict upon binding to the cells lining the intestinal mucosa. Lectins may therefore be responsible for reported cases of human intoxication associated with the consumption of inadequately cooked beans. Lathyrism and favism are diseases in man which are associated with the consumption of Lathyrus sativus and Vicia faba respectively. Evidence leading to the probable identification of the causative factors of these diseases and the steps necessary for their elimination will be discussed.
Source: Medline 84023099; Reprinted with permission Copyright 1983 Springer Verlag
Favism etiology/ Lathyrism etiology/ Lectin toxicity/ Protease Inhibitors toxicity/ Diet/ Food Contamination/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Lathyrus sativus/ Contamination/ Favism/ Food/ Glycine max/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism nutrition/ Lathyrus toxicity/ Lectin/ Humans/ Models/ Nutrition plant/ Nutrition animal/ Nutrition/ Phaseolus vulgaris Toxicity L. sativus/ Toxicity/ Toxin/ Vicia/ Vicia faba.

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Lathyrism prevention/ Lathyrus sativus/ India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism India/ Lathyrism nutrition/ Nutrition Paralysis/ Prevention lathyrism.

Spencer, P. S. and Schaumburg, H. H. (1983). **Lathyrism: a neurotoxic disease.** Neurobehavioral Toxicology and Teratology **5** (6):625-629
Lathyrism, one of the oldest neurotoxic diseases known to Man, results from excessive consumption of the chickling pea, Lathyrus sativus, and certain related species. Once prevalent throughout Europe, N. Africa, Middle East and parts of the Far East, the disease is presently restricted to India, Bangladesh and Ethiopia. Lathyrism is a form of irreversible, non-progressive spastic paraparesis associated with poorly understood degenerative changes in spinal cord. Domestic animals, notably the horse, also develop hindlimb paralysis after prolonged feeding on Lathyrus fodder. Experimental animal models of lathyrism have been reported but none has been satisfactorily investigated, and concurrence between these experimental diseases and the human condition is unproven. The culpable agent in Lathyrus species that precipitates paralysis also is unknown. Current attention is focused on the glutamate analog, beta-(N)-oxalyl-amino-L-alanine acid (BOAA). While this compound is present in those Lathyrus species that induce spastic paraparesis and, in large doses, reportedly causes neuropathological changes similar to glutamate neurotoxicity, there is little to compare these neuropathological changes with those found in human lathyrism. Chronic primate feeding studies utilizing BOAA need to be carried out to determine whether this agent is responsible for human lathyrism. Some species of Lathyrus, notably Lathyrus odoratus, are unable to induce human lathyrism but contain a compound, beta-aminopropionitrile (BAPN), that induces pathological changes in bone ('osteolathyrism') and blood vessels ('angiolathyrism') of experimental animals without damaging the nervous system. However, related compounds, dimethylaminopropionitrile (DMAPN) and beta, beta'-iminodipropionitrile (IDPN), are chronic neurotoxins in humans and animals, respectively.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: Medline 84142544
Beta Alanine isolation and purification/ Beta Alanine toxicity/ Disease Models Animal/ Lathyrism diagnosis/ Lathyrism veterinary/ Plants Toxic analysis/ Saimiri/ Lathyrism etiology/ Neurotoxins isolation and purification/ ODAP/ Neurology/ Forage/ Lathyrus sativus/ Lathyrus odoratus

Osteolathyrism/ Horses/ Agriculture/ Beta Alanine analogs and derivatives/ Africa/ Aminopropionitriles/ Bangladesh/ Blood/ Bones/ Diagnosis Ethiopia/ Europe/ Experimental lathyrism/ Feeding/ Fodder/ Glutamates/ Hindlimbs/ Horse diseases/ Horses lathyrism/ India/ India L. sativus India L. sativus consumption/ India lathyrism/ Isolation/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bangladesh Lathyrism Ethiopia/ Lathyrism experimental/ Lathyrism France/ Lathyrism horses/ Lathyrism India/ Lathyrus toxicity/ Primates/ Humans Middle East/ Models/ Nervous system/ Neurotoxicity/ Neurotoxins/ Paralysis/ Prevalence/ Purification/ Spasticity/ Spastic paraparesis/ Spinal cord/ Toxicity ODAP/ Toxicity Osteolathyrism/ BAPN/ Toxicity beta aminopropionitrile/ Toxicity L. odoratus/ Toxicity L. sativus/ Toxicity.

Spencer, P. S.; Schaumburg, H. H.; Cohn D. F., and Seth, P. K. (1983). **Lathyrism: A useful model of primary lateral sclerosis**. In: Rose, F. C. (Ed). **Research Progress in Motor Neuron Disease**, London: Pitman Medical Publishers, pp. 312-327.
Lathyrism primary lateral sclerosis model/ Lathyrism/ Lathyrism motor neurons/ Models/ Motor neurons/ Neurology/ Neurons.

Wilson, J. (1983). **Cyanide in human disease: a review of clinical and laboratory evidence.** Fundamental and Applied Toxicology **3** (5):397-399
Experimental cyanide exposure in animals causes demyelination and circumstantial clinical and laboratory evidence suggest that there are human parallels. In Leber's hereditary optic atrophy there appears to be a defect in the conversion of cyanide to thiocyanate because of deficient rhodanese activity. For transmitters of the disease smoking carries the risk of blindness and in the most severely affected patients, there is diffuse neurological disease. It is possible that other hereditary optic atrophies (dominant and recessive) may also reflect inborn errors of cyanide metabolism. In the retrobulbar neuritis and optic atrophy of vitamin B12 deficiency there may be a conditional abnormality of cyanide metabolism in smokers, and likewise in so-called tobacco-alcohol amblyopia in which there are more complex nutritional deficiencies. Epidemiological evidence (differing sex ratios, excess of smokers) indicates that defective cyanide metabolism may contribute to the development of sub-acute combined degeneration of the cord in vitamin B12 deficiency. In protein-malnourished populations consuming large amounts of cyanide or cyanogens, viz. in tropical Africa where the staple diet includes cassava containing large amounts of linamarin, similar maladies occur as acquired disorders. There may be a similar explanation for lathyrism. The known pathways of human cyanide metabolism are reviewed and evidence supporting the clinical data is presented.
Source: Medline 84058805; Reprinted with permission Copyright 1983 Academic Press
Lathyrism similarity to Cyanide toxicity/ Africa/ Cyanides/ Deficiency/ Demyelination/ Diet/ HCN/ Lathyrism/ Lathyrism animals/ Lathyrism review/ Humans/ Manihot esculenta/ Cassava/ Metabolism/ Myelin/ Optic/ Population/ Protein/ Review/ Risk/ Sex/ Thiocyanates/ Nicotiana Toxicity/ Tropics/ Vitamins.

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Source: ref ex Kaul et al. (1989)
Lathyrism prevention/ Lathyrism nutrition/ Lathyrism Vitamin C/ Vitamin C lathyrism/ Neurology/ Ascorbic acid/ Vitamin C/ Food/ Lathyrism Neurolathyrism/ Nutrition/ Prevention lathyrism/ Vitamins.

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Lathyrism India/ India lathyrism/ India/ Lathyrism/ Lathyrism nutrition/ Nutrition.

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[Lathyrism, Lathyrus sativus, India].
Source: Agricola (79-84) IND 84113221 ; reprintDE
India/ Lathyrus sativus/ Grain legumes/ Pulses/ Grain legumes India/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism India/ reprint.

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Source: Medline 84255470
Central Nervous system diseases chemically induced/ Central Nervous system diseases physiopathology/ Clioquinol/ Disease Models Animal Dogs/ Lathyrism pathology/ Paraplegia pathology/ Axons ultrastructure/ Central Nervous system diseases pathology/ Nerve Degeneration Neurology/ Axons/ Syndrome/ Central Nervous system/ Lathyrism/ Lathyrism animals/ Lathyrism nerve degeneration/ Lathyrism physiopathology/ Humans/ Models/ Nerves/ Nervous system/ Paraplegia/ Nervous system diseases.

Tiwari, B. C.; Ganeriwal, S. K., and Tiuwari, U. K. (1984). **Effect of Kesari dal on kidney enzymes in maize**. Indian Journal of Nutrition and Dietetics **21** (12):448-453.
Effect of kesari dal (Lathyrus sativus used as food by poor people in India and known to cause lathyrism] on kidney enzymes of mice was investigated by biochemical and histochemical methods in a 12 week feeding trial [10 refs, En].
Source: FSTA 17(12) 1985
Lathyrus/ Lathyrism physiopathology/ Lathyrism animal models/ Lathyrism bioassay rats/ Lathyrism pathology/ Kidneys/ Bioassay L. sativus Bioassay rodent/ Bioassays/ Biochemistry.

Ahmad, K. and Jahan, K. (1985). **Neurolathyrism and L-ascorbic acid.** Food and Nutrition Bulletin **7** (1):missing in online article (author affiliation: Kamaluddin Ahmad and Khursheed Jahan; Institute of Nutrition and Food Science, University of Dacca, Dacca, Bangladesh)

Experiments with Chicks

These studies demonstrate the toxicity of MSG in one-day-old chicks weighing 32-35 9. Different amounts of MSG were put into 0.5 ml of water and administered intraperitoneally. The results are presented in table 1. While a dose of 2 g/kg body weight caused only mild symptoms, toxicity became severe when the dose was raised to 2.5 g/ kg.

The preventive action of AA against the toxicity of MSG at a dose of 2.5 g/kg in these chicks is presented in table 2, part A, which shows that 0.75 mg of AA given intraperitoneally 10 minutes before the administration of MSG protected all the birds.

Experiments with Guinea-pigs and Monkeys

These studies were made to demonstrate the curative action of AA against MSG toxicity in adult guinea-pigs and monkeys, which are not able to biosynthesize AA. Guinea-pigs weighing 300-350 9 and monkeys weighing 2.5-3 kg were selected. They were made deficient in AA by feeding an AA-deficient diet until serum AA levels fell to 0.3-0.4 mg/dl. At this point no scorbutic symptoms were seen. A dose of 2 g/kg of MSG was administered to each animal intraperitoneally in a 0.5-ml aqueous solution. Results are shown in table 2, parts B and C. All the animals became sick, but 5 mg of AA given subcutaneously cured all of the guinea-pigs, and 50 mg cured all monkeys. These doses were arbitrary.

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Studies on the preventive and curative action of ascorbic acid on the neurological toxicity of monosodium glutamate

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INTRODUCTION

Olney and Ho and others have described the toxic effect of subcutaneous administration of large doses of monosodium glutamate (MSG) in young mice (1, 2). Degenerative changes in the retina of the infant mouse after subcutaneous treatment with MSG was reported earlier by Lucas and Newhouse (3). Potts et al. also showed that MSG caused irreversible retinal pathology (4, 5). The use of MSG in infant formula diets has raised concern lest it cause any health hazard. It was suggested that MSG could also be responsible for the Chinese-restaurant syndrome (6, 7). Studies have also exonerated MSG from this incrimination (8).

In the course of their studies on neurolathyrism caused by Lathyrus sativus (LS), various neurological manifestations were reported by V. Nagarajan and C. Gopalan in one-day- old chicks when the latter were given extracts of LS seeds intraperitoneally (9). Subsequently a neuroactive amine, b-N-oxalyl-L-a, b-diaminopropionic acid (ODAP), was isolated from the seeds of LS that mimicked the neurological symptoms caused by the extract (1012). We found that such symptoms did not appear in the chicks when they were given ascorbic acid (AA) some 10 to 15 minutes before the administration of the toxic extract of LS. It was further found that adult guinea-pigs and monkeys, which need a dietary source of AA, developed paralysis of the hind legs and sometimes respiratory difficulty if an extract of LS was administered to them after they had been fed an AA-deficient diet for some weeks to lower their serum AA level to 0.2-0.4 mg/dl. At this stage of deficiency there were no scorbutic symptoms (such as subcutaneous haemorrhage). The conditions paralleled to a great extent those seen in human neurolathyrism, but no such symptoms were seen in those animals that were not made deficient in AA prior to the administration of the toxic extract. These symptoms were found to be reversible if AA was given immediately after the appearance of symptoms. It was concluded that AA counteracted the neurotoxicity of ODAP from LS (13,14). We now provide additional data.

Glutamate has been recognized to be both neuroexcitory and neurotoxic. Biological actions of ODAP and glutamate (MSG) have been correlated (15). It occurred to us that the toxic effect of MSG reported in young animals could possibly be counteracted by AA. As described below, it has been our finding that AA does protect young animals from the neurological symptoms that arise from administration of a high dose of MSG. AA can both prevent and cure the toxic effects of MSG. Therefore, the incorporation of AA with MSG in food preparations might possibly preclude toxic reactions to MSG in human subjects.

TABLE 1. Toxicity of Monosodium Glutamate in One-Day-Old Chicks Weighing 32 to 35 Grams

Amount of MSG	Number of Animals	Observations and Remarks
MSG1.5 g/kg of body weight	30	No apparent abnormality noted.
2 g/kg of body weight	30	All animals showed drowsiness after 20-30 minutes.
2.5 g/kg of body weight	30	All developed neck drooping; 18 developed paralysis of legs, neck rigidity, and convulsions after 45-90 minutes. 25 recovered and 5 were found dead the following morning.
3 g/kg of body weight	30	27 developed neck rigidity, extensor paralysis of legs, and convulsions; hyperextension of knee and ankle joints; the remaining 3 showed tremor and failed to walk. 15 died in the following 12 hours; all but 2 died within 48 hours.

MSG was administered in a 0.51-ml aqueous solution intraperitoneally.

TABLE 2. Preventive and Curative Action of Ascorbic Acid (AA) in Glutamate (MSG) Toxicity

	Number of Animals	Amount of MSG g/ kg Body Wt.	Amount of AA, mg per Animal	Observations and Remarks
A. One-day-old chicks, 32-35 g	50	2.5	0.75a	These are minimum amounts of AA needed for prevention of neurological symptoms in all animals. AA was given 10 minutes before MSG.
B. AA-deficient guinea-pigs (300-350 g); serum AA 0.3-0.5 mg/dl	20	2.0	5b	8 animals developed drowsiness and neck droop; the rest developed weakness and paralysis of hind legs, tremor, convulsions, etc. 45-60 minutes after intraperitoneal injection of MSG. Animals were cured by administration of AA subcutaneously soon after appearance of symptoms.c
C. AA-deficient monkeys (2.5-3 kg); serum AA 0.3-0.5 mg/dl	6	2.0	50b	All animals developed paralysis of hind legs 11/2-3 hours after intraperitoneal administration of MSG; 4 developed respiratory distress. All animals were cured by administration of AA intramuscularly immediately after appearance of symptoms.c

a. Minimum preventive dose per chick
b. Administered after the symptoms appeared (arbitrary curative dose)
c. The animals were later put on a diet supplemented with ascorbic acid-guinea-pigs 5 mg/day; monkeys 50 mg/day.

EXPERIMENTS AND RESULTS

Experiments with Chicks

These studies demonstrate the toxicity of MSG in one-day-old chicks weighing 32-35 9. Different amounts of MSG were put into 0.5 ml of water and administered intraperitoneally. The results are presented in table 1. While a dose of 2 g/kg body weight caused only mild symptoms, toxicity became severe when the dose was raised to 2.5 g/ kg.

The preventive action of AA against the toxicity of MSG at a dose of 2.5 g/kg in these chicks is presented in table 2, part A, which shows that 0.75 mg of AA given intraperitoneally 10 minutes before the administration of MSG protected all the birds.

Experiments with Guinea-pigs and Monkeys

These studies were made to demonstrate the curative action of AA against MSG toxicity in adult guinea-pigs and monkeys, which are not able to biosynthesize AA. Guinea-pigs weighing 300-350 9 and monkeys weighing 2.5-3 kg were selected. They were made deficient in AA by feeding an AA-deficient diet until serum AA levels fell to 0.3-0.4 mg/dl. At this point no scorbutic symptoms were seen. A dose of 2 g/kg of MSG was administered to each animal intraperitoneally in a 0.5-ml aqueous solution. Results are shown in table 2, parts B and C. All the animals became sick, but 5 mg of AA given subcutaneously cured all of the guinea-pigs, and 50 mg cured all monkeys. These doses were arbitrary.

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beta-N-Oxalylamino-L-alanine (BOAA) is a dicarboxylic diamino acid present in Lathyrus sativus (chickling pea). Excessive oral intake of this legume in remote areas of the world causes humans and animals to develop a type of spastic paraparesis known as lathyrism. BOAA is one of several neuroactive glutamate analogs reported to stimulate excitatory receptors and, in high concentrations, cause neuronal vacuolation and necrosis. The present study investigates the action of BOAA in vitro on CNS high-affinity transport systems for glutamate, gamma-aminobutyric acid (GABA), aspartate, glycine, and choline and in the activity of glutamate decarboxylase (GAD), the rate-limiting enzyme in the decarboxylation of glutamate to GABA. Crude synaptosomal fractions (P2) from rat brain and spinal cord were used for all studies. [3H]Aspartate transport in brain and spinal cord synaptosomes was reduced as a function of BOAA concentration, with reductions to 40 and 30% of control values, respectively, after 15-min preincubation with 1 mM BOAA. Under similar conditions, transport of [3H]glutamate was reduced to 74% (brain) and 60% (spinal cord) of control values. High-affinity transport of [3H]GABA, [3H]glycine, and [3H]choline, and the enzyme activity of GAD, were unaffected by 1 mM BOAA. While these data are consistent with the excitotoxic (convulsant) activity of BOAA, their relationship to the pathogenesis of lathyrism is unknown.
Source: Medline 85133654; Reprinted with permission Copyright 1989 Raven Press
Beta Alanine pharmacology/ Aspartic Acid metabolism/ Biological Transport Active drug effects/ Brain drug effects/ Choline metabolism Glutamates metabolism/ GABA metabolism/ Rats/ Rats Inbred Strains/ Spinal Cord drug effects/ Synaptosomes drug effects/ Alanine analogs and derivatives/ Brain metabolism/ Neuroregulators metabolism/ Spinal Cord metabolism/ Synaptosomes metabolism/ Rodents/ ODAP Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Synaptosomes/ Aminobutyric Acids/ Aspartic acid/ Brain/ Central Nervous system/ Drugs/ Enzymes/ GABA/ Glutamates/ Glycine/ In vitro/ Intake/ Lathyrism/ Lathyrism animals/ Lathyrism rats/ Humans/ Metabolism Nervous system/ Receptors/ Spasticity/ Spastic paraparesis/ Spinal cord/ Strains/ Synapses.

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Source: Medline 87038379
Adult/ Alzheimer's Disease pathology/ Environmental Exposure/ Guam/ Lathyrism pathology/ Lathyrism physiopathology/ Neuromuscular Diseases pathology/ Neurons pathology/ Neurons physiopathology/ Parkinson Disease pathology/ Poliomyelitis pathology/ Poliomyelitis physiopathology/ Pyridines adverse effects/ Time Factors/ Aging/ Alzheimer's Disease etiology/ Motor Neurons/ Neuromuscular Diseases etiology/ Parkinson Disease etiology/ Lathyrism symptoms/ Syndrome/ Age/ Amyotrophic lateral sclerosis/ Central Nervous system Environment/ Infection/ Lathyrism/ Lathyrism etiology/ Lathyrism mechanisms/ Lathyrism prevention/ Mechanism/ Motor neurons/ Nervous system/ Neurodegenerative/ Neurology/ Neuromuscular/ Neurons/ Prevention lathyrism/ Lathyrism prevention/ Pyridines/ Symptoms lathyrism.

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exotic germplasm had comparatively bigger seeds than the local cultivars. The protein and BOAA percent ranged from 24.54 to 34.05 and 0.22 to 2.08, respectively. A significant positive correlation was obtained only between seed size and protein content (0.775) but negative association was obtained between seed size and BOAA. There was no association between the content of protein and BOAA. Therefore, it may be feasible to develop low neurotoxin varieties by selecting for bold seed size following hybridization of bold seeded and low neurotoxin types with those having small seeds and high neurotoxin.
Source: CODIS 88-100600
Lathyrus sativus ODAP/ Lathyrus sativus protein/ Genetic resources L. sativus Bangladesh/ Seed size L. sativus Bangladesh/ Bangladesh L. sativus genetic resources/ Genetic variation L. sativus Bangladesh/ Lathyrus sativus/ Agriculture/ Genetic resources/ Amino acids/ Bangladesh Cultivars/ Genetic variation/ Lathyrism/ Lathyrism Bangladesh/ Humans/ Neurotoxins/ ODAP/ Paralysis/ Protein/ Protein content/ Seed/ Seed size/ Varieties/ Genetic resources L. sativus.

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Lathyrus/ History/ Archaeobotany/ France/ Lathyrus sativus/ Lathyrus cicera/ Age/ Lathyrism France/ Lathyrism history/ Lathyrism L. cicera reprint.

Murti, V. V. S. (1986). **Neurotoxic activity of some oxalyl-amino acids**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 318-320.
Source: reprintDE
Lathyrus toxicity/ Oxalyl-amino acids neurotoxicity/ NPAA/ NPAA L. sativus/ Neurology/ Lathyrus sativus/ Amino acids/ France/ Lathyrism Neurotoxicity/ Neurotoxins/ Toxicity L. sativus/ Toxicity/ reprint.

Narayan, R. K. J. (1986). **DNA changes in chromosome differentiation and evolution in Lathyrus**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 67-79.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ Chromosomes/ Differentiation/ DNA/ Evolution/ France/ reprint.

Plitmann, U.; Heyn, C. C., and Weinberger, H. (1986). **Comparative taxonomy of some wild species allied to Lathyrus sativus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 8-21.
Source: reprintDE
Lathyrus sativus related spp/ Taxonomy Lathyrus spp/ Taxonomy L. sativus et al./ Lathyrus gorgoni/ Lathyrus pseudocicera/ Lathyrus sativus Taxonomy/ France/ Lathyrus spp/ Taxonomy L. sativus/ Wild species/ Wild/ reprint.

Quader, M.; Ramanujam, S., and Barat, G. K. (1986). **Genetics of flower colour, BOAA content and their relationship in Lathyrus sativus L**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 93-97.
Source: reprintDE
Lathyrus/ ODAP/ Lathyrus sativus/ Colour/ Flower colour/ Flower colour genetics/ Flowers/ France/ Genetics/ Genetics flower colour/ Genetics ODAP/ reprint.

Rees, H. (1986). **The consequences of DNA change in chromosomes**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 86-89.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ Chromosomes/ DNA/ France/ reprint.

Rouge, P.; Garcia, M.-L.; Boisseau, C., and Causse, H. (1986). **Immunochemical crossreactions between Lathyrus lectins and isolectins measured by an enzyme linked immunosorbent assay (ELISA) technique: phylogenetical and taxonomical implications**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 265-272.
Source: reprintDE

ELISA/ Enzymes/ France/ Isolectins/ Lathyrus spp/ Lectin/ reprint.

Rouge, P.; Ranfaing, P.; Pere, D.; Richardson, M.; Yarwood, A., and Sousa-Cavada, B. (1986). **Amino acid sequence and structure of Lathyrus lectins as a tool for the molecular aspects of Lathyrus speciation**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 273-284.
Source: reprintDE
Amino acids/ Amino acid sequence/ France/ Lectin/ Molecular/ Speciation/ Lathyrus spp/ reprint.

Roy, D. N.; Spencer, P. S., and Nunn, P. B. (1986). **Toxic components of Lathyrus**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 287-296.
Source: reprintDE
Lathyrus toxicity review/ France/ Lathyrism review/ Lathyrus toxicity/ Review/ Toxicity/ reprint.

Sharma, A. K.; Chowdhury, R. K., and Mukherjee, S. (1986). **DNA content and repetitive DNA in Lathyrus sativus at intraspecific level**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 80-85.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ DNA/ DNA content/ France/ Intraspecific/ Repetitive DNA/ reprint.

Simola, L. K. (1986). **Structural and chemical aspects of evolution of Lathyrus species**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 225-239.
Source: reprintDE
Leaf anatomy/ NPAA/ NPAA tissue distribution/ NPAA plant development/ Lathyrus seed protein serology/ Seed protein serology/ Lathyrus niger/ Lathyrus maritimus/ Lathyrus sylvestris/ Lathyrus japonicus/ Anatomy plant/ Chemotaxonomy/ Evolution/ France/ Lathyrus sylvestris Leaves/ Plant development/ Protein/ Seed/ Seed proteins/ Taxonomy/ Tissue distribution/ reprint.

Singh, S. P. and Misra, B. K. (1986). **50 years of Lathyrus sativus research**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 240-245.
Source: reprintDE
Lathyrus sativus research history/ Lathyrus sativus/ France/ History/ Lathyrism/ Lathyrism history/ reprint.

Spencer, P. S. and Kaul. A. K. (1986). **INILSEL (International networks for the improvement of Lathyrus sativus and eradication of lathyrism). Outline and preliminary proposal**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 325-330.
Source: reprintDE
Lathyrus/ Lathyrus sativus/ Lathyrus sativus/ France/ INILSEL/ reprint.

Spencer, P. S.; Ludolph, A. C.; Dwivedi, M. P.; Roy, D. N.; Hugon, J., and Schaumburg, H. H. (1986). **Lathyrism: Evidence for role of the neuroexcitory amino acid BOAA**. The Lancet **Nov.1986**:1066-1067
Source: reprintDE
NPAA toxicity/ ODAP toxicity/ Lathyrus sativus toxicity/ Lathyrism etiology/ Lathyrus sativus/ Amino acids/ Amino acids toxicity/ Lathyrism Lathyrism ODAP toxicity/ Lathyrus toxicity/ NPAA/ ODAP/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ reprint.

Spencer, P. S.; Roy, D. N.; Ludolph, A.; Hugon, J.; Dwivedi, M. P., and Schaumburg, H. H. (1986). **Lathyrism: evidence for role of the neuroexcitatory amino acid BOAA.** The Lancet **2** (8515):1066-1067
Lathyrism, a form of motorneuron disease induced by excessive consumption of the legume Lathyrus sativus (chickling pea), presents as signs of pyramidal tract involvement. Primate feeding studies show that beta-N-oxalylamino-L-alanine (BOAA), a potent neuroexcitatory amino acid in the chickling pea, induces corticospinal dysfunction similar to that seen in animals consuming a fortified diet of this legume. BOAA, a potent agonist of the excitatory neurotransmitter glutamate, is likely to be causally associated with lathyrism in man.
Source: Medline 87038378
Beta Alanine toxicity/ Adolescence/ Adult/ Child/ Disease Models Animal/ Lathyrism chemically induced/ Macaca fascicularis/ Alanine analogs and derivatives/ Central Nervous system drug effects/ Lathyrism physiopathology/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ Central Nervous system/ Diet/ Drugs/ Feeding/ Glutamates/ Lathyrism/ Lathyrism Adolescence/ Lathyrism animals/ Lathyrus toxicity/ Macaca/ Primates/ Humans/ Models/ Motor neurons/ Nervous system/ Neuroexcitatory Neurons/ Pyramidal tract/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Spencer, P. S.; Roy, D. N.; Palmer, V. S., and Dwivedi, M. P. (1986). **Lathyrus sativus L: The need for a strain lacking human and animal neurotoxic properties**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 297-305.
Source: reprintDE
ODAP/ Lathyrism/ Lathyrus sativus/ France/ Lathyrism animals/ Humans/ Neurotoxins/ Strains/ reprint.

Tiwari, O. P.; Agrawal, I., and Lal, M. S. (1986). **Studies on population densities in Lathyrus sativus L. in Madhya Pradesh, India**. In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 184-186.
Source: reprintDE
Lathyrus/ India L. sativus/ Madhya Pradesh L. sativus/ Lathyrus sativus/ France/ India/ India Madhya Pradesh/ India lathyrism/ Lathyrism Lathyrism India/ Madhya Pradesh/ Population/ reprint.

Toulemonde, C. and Vartanian, N. (1986). **Drought resistance of diploid and tetraploid cytotypes of Lathyrus pratensis L.** In: Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 187-196.
Source: reprintDE
Lathyrus pratensis/ Drought resistance L. pratensis/ Cytology L. pratensis/ Climate/ Cytology/ Drought/ Drought resistance/ France/ Resistance Tetraploid/ reprint.

Valero, M.; Youssef, A., and Vernet, P. (1986). **Is there polymorphism in the breeding system of Lathyrus latifolius?** Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 105-117.
Source: reprintDE
Lathyrus latifolius breeding polymorphism/ Polymorphism L. latifolius/ Breeding/ Genetics/ France/ Lathyrus latifolius/ Polymorphisms/ reprint.

Yamamoto, K.; Fujiware, T., and Blumenreich, I. D. (1986). **Isozymic variation and interspecific crossability in annual species of the genus Lathyrus**. Kaul, A. K. and Combes, D. (Eds). **Lathyrus and Lathyrism. Proceedings of the International Symposium 9-13 September France**, New York: Third World Medical Research Foundation, pp. 118-129.
Source: reprintDE
Lathyrus/ Lathyrus hierosolymitanus/ Lathyrus pseudocicera/ Lathyrus blepharicarpus/ Lathyrus marmoratus/ Lathyrus gorgonii/ Lathyrus hirsutus/ Lathyrus nissolia/ Lathyrus aphaca/ Lathyrus articulatus/ Interspecific hybridisation sect. Cicercula/ Isozymes L. sativus/ Isozymes L. hierosolymitanus/ Isozymes L. pseudocicera/ Isozymes L. blepharicarpus/ Isozymes L. marmoratus/ Isozymes L. gorgonii/ Isozymes L. cicera Isozymes L. odoratus/ Isozymes L. hirsutus/ Isozymes L. ochrus/ Isozymes L. tingitanus/ Isozymes L. clymenum/ Isozymes L. nissolia/ Isozymes L. aphaca/ Isozymes L. articulatus/ Lathyrus sativus/ Lathyrus cicera/ Lathyrus ochrus/ Lathyrus clymenum/ Lathyrus tingitanus/ Lathyrus odoratus/ Isozymes/ Biochemistry/ Cicercula/ France/ Interspecific/ Interspecific hybridisation/ Lathyrism Biochemistry/ Lathyrism L. cicera Lathyrism L. clymenum/ Lathyrus gorgoni/ reprint.

Bisby, F. A.; Allkin, R.; Otto, B. A., and Almeida, M. T. (1987). **Genetic resources of medically important Vicieae (vetches and peas)**. In: Mota, M. and Baeta, J. (Eds). **International symposium on conservation of genetic resources of aromatic and medicinal plants, 9-11 May, 1984, Oeiras, Portugal**, Oeiras, Portugal: pp. 51-56. (author affiliation: Vicieae Database Project, Dep. Biol., Southampton Univ., SO9 5NH, UK).
The Vicieae Seed Collection of Southampton University, whose recent accessions have been mainly of seed collected from wild plants or seed multiplied from such sources, includes accessions of Vicia, Lathyrus, Lens and Pisum. The collection has been used to investigate the blood-group specific lectins produced by several Vicia species. Of the 8 accessions thought to be V. graminea (a source of anti-N lectins), 7 were tentatively identified as V. epetiolaris and only one as V. graminea. The collection has also been used to investigate lathyrism, a nervous disorder caused by excess 2-amino-3-oxalylaminopropionic acid from Lathyrus sativus seeds in the diet. Other Lathyrus species containing the neurotoxin are listed.
Source: Copyright CAB Abstracts (87-89) P716729
Lathyrus/ Gene banks/ UK/ Vicia/ Vicia graminea/ Plant composition/ Lectin/ Vicia epetiolaris/ Neurotoxins/ Lathyrus sativus/ Vicieae Agriculture/ Genetic resources/ Blood/ Conservation/ Databases/ Diet/ Genes/ Lens/ Medicinal/ Pisum/ Portugal/ Seed/ Wild.

Campbell, C. G. and Briggs, C. J. (1987). **Registration of low neurotoxin content Lathyrus germplasm LS 8246.** Crop Science **27** (4):821 (author affiliation: Agriculture Canada Research Station, Morden, Manitoba, R0G 1JO, Canada)
This L. sativus germplasm line is low in the neurotoxin beta-N-oxalyl-L-alpha-beta-diamino propionic acid (ODAP), a causal agent of the neurodegenerative disorder lathyrism. It was developed from a single plant of

Pusa 24, a low-ODAP line bred in India. ODAP concentration in seed of LS8246 ranged from 259 to 401 µg/g over 3 years, compared to 2615 µg/g for Pusa 24 in a single year.
Source: Copyright CAB Abstracts (87-89) P662114
Genetic resources releases/ Canada/ Plant composition/ Neurotoxins/ ODAP/ Lathyrus sativus/ Agriculture/ Genetic resources/ India/ India L. sativus/ India lathyrism/ India Lathyrus genetic resources/ Lathyrism/ Lathyrism India/ Manitoba/ Neurodegenerative/ Neurology/ Seed.

Choi, D. W. (1987). **Ionic dependence of glutamate toxicity**. Journal of Neuroscience **7**:369-379
ODAP/ Glutamates toxicity ionic influence/ ODAP toxicity ionic dependence/ Lathyrism/ Neurology/ Glutamates/ Glutamates toxicity Lathyrism ODAP toxicity/ Toxicity ODAP/ Toxicity.

Gupta, Y. P. (1987). **Anti nutritional and toxic factors in food legumes: a review.** Plant Foods for Human Nutrition **37** (3):201-228 (author affiliation: Division of Agricultural Biochemistry, Indian Agricultural Research Institute, New Delhi)
A comprehensive review on the presence of certain important anti-nutritional and toxic factors in food legumes has been conducted. These substances include proteolytic inhibitors, phytohemagglutinins, lathyrogens, cyanogenetic compounds, compounds causing favism, factors affecting digestibility and saponins. These factors are shown to be widely present in leguminous foods which are important constituents of the diet of a large section of the world's population, and particularly, of people in the developing countries.
Source: Medline 89184239
Cookery/ Favism etiology/ Glycosides adverse effects/ Hydrocyanic Acid adverse effects/ Lathyrism etiology/ Lectins adverse effects/ Protease Inhibitors adverse effects/ Saponins adverse effects/ Legumes adverse effects/ Biochemistry/ Nutritional value/ Antinutritional factors/ Protease inhibitor/ Agriculture/ Saponins/ Glycosides/ Delhi/ Diet/ Digestibility/ Favism/ Food/ India/ India Dietary/ Dietary/ India lathyrism/ Lathyrism Lathyrism Biochemistry/ Lathyrism India/ Lathyrism nutrition/ Lathyrism review/ Lathyrogens/ Humans/ Nutrition plant/ Nutrition/ Population Review.

Jha, K. (1987). **Effect of the boiling and decanting method of Khesari (Lathyrus sativus) detoxification, on changes in selected nutrients.** Archivos Latinoamericanos De Nutricion **37** (1):101-7 (author affiliation: College of Basic Sciences and Humanities, Rajendra Agricultural University, Pusa, Samastipur, India)
It is a well-known fact that the legume Khesari (Lathyrus sativus) causes lathyrism, a disease characterised by paralysis of the lower limbs in human beings. The toxic constituent is an amino acid identified as B-Oxalyl-Amino L-Alanine (BOAA). It has been reported that if the legume is boiled for two hours and the water is then decanted, almost 85% of the toxic amino acid is eliminated. Therefore, this investigation constitutes an effort to prevent the loss of other nutrients, simultaneously to the elimination of toxicity. As has been observed, as much as half the protein content, as well as 80.36% total sugars, 63.13% reducing sugars, 86.05% amino acids, and all thiamine, riboflavin and niacin are lost from dhal (dehulled, separated cotyledons), while the respective losses from the whole seeds are 47.25%, 45.73%, 74.69% and 80.00%, and all vitamins, in just a one-hour treatment. The losses of the toxic amino acid from dhal and whole seeds are 71.46% and 68.74%, respectively. The data for losses occurring in the two-hour and three-hour treatment are also described.
Source: reprintDE
Lathyrus sativus detoxification/ Lathyrus sativus nutritive value/ Processing L. sativus/ Toxicity/ ODAP/ Nutritional value/ Lathyrus sativus Agriculture/ Amino acids/ Cotyledons/ Detoxification/ Dhal/ India/ India L. sativus/ India lathyrism/ Khesari/ Lathyrism/ Lathyrism India Lathyrus toxicity/ Humans/ Nutrients/ Paralysis/ Processing/ Protein/ Protein content/ Riboflavin/ Seed/ Thiamine/ Toxicity ODAP/ Toxicity L. sativus/ Vitamins/ Water detoxification/ Water/ reprint/ Detoxification L. sativus/ Lathyrus sativus detoxification.

Lewin, R. (1987). **Environmental hypothesis for brain diseases strengthened by new data**. Research News.
Source: CGC_95_2
Lathyrism/ Incomplete/ Neurology/ Brain/ Brain diseases/ Environment.

Ludolph, A. C.; Hugon, J.; Dwivedi, M. P.; Schaumburg, H. H., and Spencer, P. S. (1987). **Studies on the aetiology and pathogenesis of motor neuron diseases. 1. Lathyrism: clinical findings in established cases.** Brain **110** (1):149-165
Lathyrism is a toxic disease of the motor system constantly associated with primary consumption of the seed of Lathyrus sativus (chickling or grass pea). Neurological examination was performed on 38 affected subjects drawn from four regions of the Indian subcontinent endemic for lathyrism. All showed a consistent and largely symmetric pattern of neurological deficit similar to that displayed by 5 Europeans with longstanding lathyrism now living in Israel. Hallmarks of lathyrism include a pyramidal pattern of motor weakness combined with greatly increased tone in the thigh extensors and adductors and in the gastrocnemius muscles so that the more severely affected walk on the balls of their feet with a lurching scissoring gait. Extensor plantar responses are uniformly present in such cases, and the knee and ankle tendon reflexes are exaggerated and often clonic. Hoffmann signs and exaggerated biceps and/or triceps tendon jerks are also found in the most severely affected. Sensory signs are absent, although perverse sensations in the legs are frequently

reported at the onset. Walking difficulties commonly begin suddenly but may also appear subacutely or insidiously. Some individuals experience partly reversible symptoms suggestive of a diffuse CNS excitation of somatic, motor and autonomic function.
Source: Medline 87101976; Reprinted with permission Copyright 1987 Macmillian Journals Ltd, UK
Adult/ Bangladesh/ Child/ India/ Lathyrism etiology/ Middle Age/ Muscles physiopathology/ Lathyrism physiopathology/ Motor neuron disorders etiology/ Neurology/ Lathyrus sativus/ Palestine/ Lathyrism symptoms/ Age/ Brain/ Central Nervous system/ Endemic/ Gait/ India L. sativus/ India L. sativus consumption/ India lathyrism/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism motor neurons/ Lathyrus toxicity/ Humans/ Motor neurons/ Muscles/ Nervous system/ Neurons/ Reflexes/ Seed/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity/ UK.

Mannan, M. A.; Haque, A., and Mohammad, Q. D. (1987). **Lathyrism [letter].** The Lancet **1** (8525):167
Source: Medline 87114353
Amino acids Diamino toxicity/ Lathyrism etiology/ Amino acids/ Lathyrism/ Toxicity.

Moslehuddin, A. B. M.; Hang, Y. D., and Stoewsand, G. S. (1987). **Evaluation of the toxicity of processed Lathyrus sativus seeds in chicks.** Nutrition Reports International **36** (4):851-855 (author affiliation: Dep. Food Science and Technology, Cornell Univ., Geneva, NY 14456, USA)
Lathyrus sativus seeds were processed for removal or destruction of their natural toxins. Partly purified concentrates from those seeds were injected intraperitoneally into 1-day-old male White Leghorn chicks as a bioassay of the effectiveness of the processing methods. When the raw seed concentrate was given to the chicks, they showed typical neurological signs such as head retraction, neck bending and stiffening followed by immediate death. Similar symptoms were observed in chicks injected with the concentrates of the seeds soaked overnight in water or in saturated calcium carbonate followed by steaming, autoclaving and fermenting at 30°C for 30 h. All chicks died within 4 h of treatment. There were 31% and 39% survivals with the concentrates of seeds soaked overnight in water followed by washing and steaming, and seeds soaked overnight in water followed by washing, steaming and fermenting at 30° for 30 h, respectively. Results from these chick bioassays showed that washing L. sativus seeds partly removes its neurotoxins. Fermentation, steaming or autoclaving seemed to have little effect on toxin removed.
Source: Copyright CAB Abstracts (87-89) N055865 reprintDE
Lathyrus sativus toxicity/ Bioassay chicks/ Poultry diseases/ Detoxification L. sativus/ Processing L. sativus/ Lathyrus sativus detoxification Antinutritional factors/ Lathyrus sativus/ Bioassay/ Agriculture/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Lathyrism symptoms/ Calcium Chickens/ Detoxification/ Evaluation/ Fermentation/ Food/ Food processing/ Food processing L. sativus/ Fowls/ Injections/ Lathyrism Lathyrism Bioassay/ Lathyrism nutrition/ Lathyrus toxicity/ Males/ Neurotoxins/ Nutrition animal/ Nutrition/ Poultry/ Processing/ Processing methods L. sativus/ Purification/ Reports/ Seed/ Symptoms lathyrism/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Toxin/ USA Water detoxification/ Water/ Reprint.

Nunn, P. B.; Seelig, M.; Zagoren, J. C., and Spencer, P. S. (1987). **Stereospecific acute neuronotoxicity of 'uncommon' plant amino acids linked to human motor system diseases.** Brain Research **410** (2):375-379
The L-isomer of beta-N-methylamino-L-alanine (BMAA), present in free form in seed of Cycas circinalis, elicits in spinal cord cultures a pattern of acute postsynaptic neuronal vacuolation comparable to that induced by beta-N-oxalylamino-L-alanine (BOAA), an excitotoxic amino acid of greater potency isolated from seed of Lathyrus sativus. The neuronotoxic properties of these compounds may be linked to the etiology of motor-system degenerative disorders (amyotrophic lateral sclerosis and lathyrism, respectively) found in human groups that have used these plant seeds for food.
Source: Medline 87243558; Reprinted with permission Copyright 1987 Elsevier Science B.V., Amsterdam, Netherlands
Beta Alanine toxicity/ Cells Cultured/ Mice/ Neuromuscular Diseases pathology/ Seed/ Spinal Cord pathology/ Alanine analogs and derivatives Amino acids Diamino toxicity/ Neuromuscular Diseases chemically induced/ Spinal Cord drug effects/ ODAP/ Rodents/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Brain/ Cycas/ Drugs Food/ Isomerism ODAP/ Isomerism/ Lathyrism/ Lathyrism etiology/ Lathyrism pathology/ Lathyrus toxicity/ Humans/ Neuromuscular/ ODAP isomerism/ Spinal cord/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Roman, G. C. (1987). **Tropical myelopathies and myeloneuropathies.** Bulletin of the Pan American Health Organization **21** (3):293-305 (author affiliation: Dep. Neurology, Texas Tech Univ., H.S.C. School of Medicine, Lubbock, TX 79439, USA)
Information available on known tropical myelopathies is reviewed and their main forms and features are described. The two main forms of tropical myelopathy are tropical ataxic neuropathy, a myeloneuropathy with prominent sensory ataxia, and tropical spastic paraparesis, a myelopathy with predominantly spastic paraplegia and minimal sensory deficit. These conditions arise from many causes associated with malnutrition, postinfectious tropical malabsorption, chronic cyanide intoxication from excessive cassava consumption, and lathyrism.
Source: Copyright CAB Abstracts (87-89) N072549 also published in Spanish in Boletin de la Oficina Sanitaria Panamericana (1986) 101, 452-462.

Nervous system diseases aetiology/ Nutrition/ Tropics/ Lathyrism/ Tropical myelopathies/ Tropical myeloneuropathies/ T Myelopathies Myeloneuropathies/ Neurology/ Famine/ Malnutrition/ Ataxia/ Australia/ Cyanides/ HCN/ Lathyrism nutrition/ Malabsorption/ Humans Manihot esculenta/ Cassava/ Myelopathy/ Nervous system/ Paraplegia/ Review/ Spain/ Spasticity/ Spastic paraparesis/ Spastic paraplegia/ USA Nervous system diseases.

Roman, G. C.; Schoenberg, B. S.; Madden, D. L., and et al. (1987). **Human T-lymphotrophic virus type 1 antibodies in the serum of patients with tropical spastic paraparesis in the Seychelles**. Arch. Neurol **44**:605-607
Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ HTLV/ Virology/ Antibodies/ Immunology/ Lathyrism/ Lathyrism serum/ Lathyrism viral infection/ Humans/ Spasticity Spastic paraparesis/ Tropics.

Ross, S. M.; Seelig, M., and Spencer, P. S. (1987). **Specific antagonism of excitotoxic action of 'uncommon' amino acids assayed in organotypic mouse cortical cultures.** Brain Research **425** (1):120-127 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, N.Y. 10461)
Beta-N-Methylamino-L-alanine (BMAA) and beta-N-oxalylamino-L-alanine (BOAA) are chemically related excitant amino acids present in the seeds of Cycas circinalis and Lathyrus sativus, respectively. Consumption of these seeds has been linked to Guam amyotrophic lateral sclerosis (BMAA) and lathyrism (BOAA) (a form of primary lateral sclerosis). We report that the acute neuronotoxic actions of these amino acids are blocked selectively by specific glutamate receptor antagonists. Administration of BOAA and BMAA to neonatal mouse cortex explants (EC100 = 28 microM and 1.6 mM, respectively) rapidly induces postsynaptic vacuolation (PSV) and neuronal degeneration characterized by dark/shrunken (D/S) cells. BOAA-mediated neuronotoxic effects are attenuated in a concentration-dependent manner by cis-2,3-piperidine dicarboxylic acid (PDA), an antagonist of quisqualate (QA)-preferring and kainate (KA)-preferring glutamate receptors. PDA maximally protected against BOAA-induced PSV by 84% at 1 mM and D/S cells by 80% at 0.5 mM. BMAA-induced cellular changes were antagonised selectively in a concentration-dependent manner by 2-amino-7-phosphono-heptanoic acid (AP7), an N-methyl-D-aspartate (NMDA) glutamate-receptor antagonist. AP7 maximally protected against BMAA-induced PSV and D/S by 88% at 1.0 and 0.5 mM, respectively. These protective actions were selective and specific since AP7 failed to attenuate BOAA-induced alterations, and PDA was ineffective in ameliorating BMAA-induced changes. Other glutamate receptor antagonists (glutamic diethyl ester and streptomycin) failed to protect the explants from the destructive action of either toxin. Taken collectively, our data indicate that the acute neuronotoxic actions of BOAA and BMAA (or a metabolite) operate through different glutamate receptor species.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: Medline 88108792; Reprinted with permission Copyright 1987 Elsevier Science B.V., Amsterdam, Netherlands
Beta Alanine antagonists and inhibitors/ Beta Alanine pharmacology/ Amino acids pharmacology/ Amino acids Diamino pharmacology/ Dose Response Relationship Drug/ Mice/ Mice Inbred Strains/ Neurotoxins pharmacology/ Osmolar Concentration/ Pipecolic Acids pharmacology Tissue Culture/ Alanine analogs and derivatives/ Amino acids Diamino antagonists and inhibitors/ Cerebral Cortex drug effects/ Neurotoxins antagonists and inhibitors/ Rodents/ NPAA/ ODAP toxicity/ Toxicity ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Antagonism amino acids/ Aspartic acid/ Brain Cerebral Cortex/ Cycas/ Drugs/ Glutamates/ Glutamates receptors/ Guam/ Kainic acid/ Lathyrism/ Lathyrism ODAP toxicity/ Lathyrus toxicity Neurotoxins/ NMDA/ NPAA rodents/ ODAP/ Pipecolic acid/ Receptors/ Reports/ Seed/ Strains/ Streptomycin/ Toxicity L. sativus/ Toxicity Toxin.

Ross, S. M. and Spencer, P. S. (1987). **Specific antagonism of behavioural action of 'uncommon' amino acids linked to motor system diseases.** Synapse **1** (3):248-253
Beta-N-methylamino-L-alanine (BMAA) and beta-N-oxalylamino-L-alanine (BOAA) are chemically related amino acids present in the seeds of Cycas circinalis and Lathyrus sativus, respectively. Consumption of these seeds has been linked to Guam amyotrophic lateral sclerosis (BMAA) and lathyrism (BOAA; a form of primary lateral sclerosis). A single large dose of BOAA or BMAA causes seizures in newborn mice and postsynaptic neuronal oedema and degeneration in CNS explants. We report that the acute neurotoxic actions of these amino acids are blocked selectively by specific glutamate-receptor antagonists (administered intracerebroventricularly) (i.c.v.) prior to the amino acid. Administration of BOAA i.c.v. to neonatal mice (ED100 = 50 micrograms) elicits a spectrum of time-dependent behavioural states including arm and leg rigidity, convulsions, and resting tremor. These are blocked in a dose-dependent manner by cis-2,3-piperidine dicarboxylic acid (PDA), an antagonist of quisqualate (QA)-preferring (A2) and kainate (KA)-preferring (A3) glutamate receptors (ED50s; 2.8 micrograms, rigidity; 1.4 micrograms, convulsions; 2.4 micrograms, resting tremor). BMAA induces a transitory hyperexcitable state followed by a long-lasting whole-body shake/wobble (ED100 = 1,000 micrograms, i.c.v.). These responses are antagonised selectively and dose-dependently by 2-amino-7-phosphonoheptanoic acid (AP7), an N-methyl-D-aspartate (NMDA) or A1 glutamate-receptor antagonist (ED50 = 0.45 microgram). Taken collectively, our data indicate that the acute neuronotoxic actions

of BOAA and BMAA (or a metabolite) operate through different glutamate-receptor species. BMAA likely exerts most of its action indirectly via the A1 glutamate receptor, while BOAA acts principally at the A2 and or A3 receptor.
Source: Medline 89100770
Beta Alanine pharmacology/ Amino acids administration and dosage/ Amino acids Diamino pharmacology/ Cerebral Ventricles drug effects Dose Response Relationship Drug/ Injections Intraventricular/ Mice/ Pipecolic Acids pharmacology/ Reference Values/ Amino acids pharmacology/ Cerebral Ventricles physiology/ Motor Activity drug effects/ Rodents/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amyotrophic lateral sclerosis/ Antagonism amino acids/ Aspartic acid Central Nervous system/ Convulsions/ Cycas/ Drugs/ Glutamates/ Glutamates receptors/ Guam/ Injections/ Kainic acid/ Lathyrism/ Nervous system/ Neurotoxins/ NMDA/ Oedema/ Physiology not plant/ Pipecolic acid/ Receptors/ Reports/ Seed.

Spencer, P. S. (1987). **Guam ALS/parkinsonism dementia: a long latency neurotoxic disorder caused by 'slow toxin(s)' in food?** Canadian Journal of Neurological Sciences **14** (3 Suppl):347-357 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, N.Y. 10461)
Parkinsonism (P) with progressive dementia (D) of the Alzheimer type is recognized as a clinical variant of a form of amyotrophic lateral sclerosis (ALS) that has occurred in high incidence among the Chamorro people of the islands of Guam and Rota in the Marianas chain of Micronesia. The declining annual incidence, upward shifting of the age of onset, narrowing of the sex ratio, and occurrence of the disease among non-Chamorros, point to a disappearing environmental causation peculiar to the traditional culture of these islands. Evidence is presented in support of the proposal that heavy use of certain toxic plants, notably cycads, a traditional source of food and medicine for the Chamorro people, plays an important aetiological role. Clinical and epidemiological approaches are offered to test for a relationship between ALS/P-D and long-latency plant toxicity.
Source: Medline 88052270
Alzheimer's Disease etiology/ Alzheimer's Disease physiopathology/ Amyotrophic Lateral Sclerosis etiology/ Amyotrophic Lateral Sclerosis physiopathology/ Guam/ Lathyrism physiopathology/ Neurotoxins adverse effects/ Parkinson Disease Symptomatic chemically induced Parkinson Disease Symptomatic physiopathology/ Alzheimer's Disease epidemiology/ Amyotrophic Lateral Sclerosis epidemiology/ Diet Parkinson Disease Symptomatic epidemiology/ Plants Toxic/ Toxicity/ Neurology/ Age/ Amyotrophic lateral sclerosis/ Environment Epidemiology lathyrism/ Food/ Incidence/ Lathyrism/ Lathyrism epidemiology/ Lathyrism etiology/ Neurotoxins/ Sex/ Toxic plants/ Toxin.

Spencer, P. S.; Hugon, J.; Ludolph, A. C.; Nunn, P. B.; Ross, S. M.; Roy, D. N., and Schaumburg, H. H. (1987). **Discovery and partial characterization of primate motor system toxins**. Ciba Found Symp, Vol. 126, pp. 221-238. ISBN: ISSN 0300-5208.
beta-N-Oxalylamino-L-alanine (BOAA) and beta-N-methylamino-L-alanine (BMAA) are chemically related excitant amino acids isolated from the seed of Lathyrus sativus (BOAA) and Cycas circinalis (BMAA), consumption of which has been linked to lathyrism (an upper motor neuron disorder) and Guam amyotrophic lateral sclerosis (ALS), respectively. Both diseases are associated with degeneration of motor neurons. Experimentally, single doses of BOAA or BMAA induce seizures in neonatal mice and postsynaptic neuronal oedema and degeneration in explants of mouse spinal cord and frontal cortex. Preliminary studies show that these behavioural and pathological effects are differentially blocked by glutamate-receptor antagonists. In macaques, several weeks of daily oral doses of BOAA produce clinical and electrophysiological signs of corticospinal dysfunction identical to those seen in comparably well-nourished animals receiving a fortified diet based on seed of Lathyrus sativus. By contrast, comparable oral dosing with BMAA precipitates tremor and weakness, bradykinesia and behavioural changes, with conduction deficits in the principal motor pathway. BOAA and BMAA (or a metabolite thereof) are the first members of the excitotoxin family to have been shown to possess chronic motor-system toxic potential. These observations provide a rational basis for searching for comparable endogenous neurotoxins in sporadic and inherited forms of human motor neuron disease.
Source: Medline 87217798
Lathyrism etiology/ Macaca/ Neuromuscular Diseases etiology/ Alanine analogs and derivatives/ Amino acids Diamino poisoning/ Motor Neurons/ Neuromuscular Junction drug effects/ Neurons drug effects/ ODAP/ NPAA toxicity/ Rodents/ Neurology/ Antinutritional factors Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Amino acids toxicity/ Amyotrophic lateral sclerosis/ Cycas/ Diet/ Drugs/ Endogenous/ Frontal cortex/ Glutamates/ Guam/ Lathyrism/ Lathyrism animals/ Lathyrism motor neurons Lathyrus toxicity/ Primates/ Humans/ Mice/ Motor neurons/ Neuromuscular/ Neurons/ Neurotoxins/ NPAA/ NPAA rodents/ Oedema Receptors/ Seed/ Spinal cord/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Toxin.

Spencer, P. S.; Ross, S. M.; Nunn, P. B.; Roy, D. N., and Seelig, M. (1987). **Detection and characterization of plant derived amino acid motorsystem toxins in mouse CNS cultures.** Prog Clin Biol Res **253**:349-361
Source: Medline 88125156
beta Alanine pharmacology/ Beta Alanine toxicity/ Cell Survival drug effects/ Cells Cultured/ Central Nervous system drug effects/ Central Nervous system pathology/ Mice/ Neurons drug effects/ Alanine analogs and derivatives/ Central Nervous system cytology/ Lathyrism chemically induced/ Neuromuscular Diseases chemically induced/ Neurons cytology/ Neurotoxins pharmacology/ Plants Toxic/ Rodents Antinutritional factors/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ Cytology/ Drugs/ Lathyrism/ Lathyrism pathology/ Nervous system/ Neurology/ Neuromuscular/ Neurons/ Neurotoxins/ Survival/ Toxicity/ Toxin.

Agid, Y.; Pertuiset, B., and Dubois, B. (1988). **Motoneuron disease as manifestation of lupin seed toxicity [letter].** The Lancet **1** (8598):1347
Source: Medline 88232059
Lathyrism Alkaloids adverse effects/ Lathyrism etiology/ Neuromuscular Diseases/ Neuromuscular diseases Lathyrus/ Toxicity/ Alkaloids Lathyrism/ Lathyrus toxicity/ Lupinus/ Motor neurons/ Neuromuscular/ Neurology/ Neurons/ Seed.

Arya, L. S.; Qureshi, M. A.; Jabor, A., and Singh, M. (1988). **Lathyrism in Afghanistan.** Indian Journal of Pediatrics **55** (3):440-442
Source: Medline 89138569
Afghanistan lathyrism/ Lathyrism Afghanistan/ Lathyrism Adolescence/ Adolescent lathyrism/ Afghanistan/ India/ India lathyrism/ Lathyrism Lathyrism India.

Briggs, C. J. (1988). **Analysis of b-N-oxalylamino-L-alanine**. Paper Presented at the Conference on Lathyrus Sativus L and the Eradication of Lathyrism 2-6 May 1988 London, UK (Ciba Foundation, London)
ODAP analysis/ Lathyrus sativus/ ODAP/ UK.

Chowdhury, S. D. (1988). **Lathyrism in poultry: a review.** World's Poultry Science Journal **44** (1):7-16 (author affiliation: Division of Biochemistry and Physiology, Wye College, Univ. London, Wye, Ashford, Kent TN25 5AH, UK)
The effects on poultry of the toxic constituents of legume seeds of the genus Lathyrus which give rise to lathyrism in humans and experimental animals are reviewed and discussed. The limited amount of information available indicates that the toxic effects depend mainly on the species and age of birds, the amount of toxins absorbed, the route of administration and the duration of exposure. Seeds of Lathyrus species (a low cost protein source) could be utilised to a greater extent in poultry diets provided safe inclusion levels were established and ways of improving feed value estimated and applied. With regard to safety margins, the results of a recent study using laying fowls suggest that the seeds of certain species contain sufficiently low concentrations of toxins for them to be used without any deleterious effects on egg production or egg shell quality.
Source: reprintDE
Lathyrus/ Toxicity/ Poultry/ Lathyrism/ Leguminosae/ Seed/ Poisonous plants/ Biochemistry/ Nutritional value/ Antinutritional factors Agriculture/ Age/ Diet/ Egg production/ Eggs/ Feed/ Feed value/ Fowls/ Lathyrism animals/ Lathyrism Biochemistry/ Lathyrism review Lathyrus toxicity/ Layers/ Humans/ Physiology not plant/ Protein/ Quality/ Review/ Toxin/ UK/ reprint.

Chowdhury, S. D. and Davis, R. H. (1988). **Lathyrism in laying hens and increases in egg weight.** Veterinary Record **123**:272-275
Source: reprintDE
Osteolathyrogens poultry/ Egg weight beta aminopropionitrile toxicity/ Toxicity Osteolathyrism/ Osteolathyrism/ Agriculture Aminopropionitriles/ Eggs/ Lathyrism veterinary/ Layers/ Poultry/ BAPN/ Toxicity beta aminopropionitrile/ Toxicity/ reprint.

Dumas, M.; Giordano, C.; Ndiaye, I. P.; Hugon, J.; Vallat, J. M., and Sonan, T. (1988). **Le concept de neuro-myelopathie tropicale. [The concept of tropical neuromyelopathy].** Bull. Soc Pathol Exot Filiales **81** (2):183-188 (author affiliation: Institut d'Epidemiologie Neurologique et de Neurologie Tropicale, Faculte de Medecine, Limoges)
Since the beginning of this century, the concept of tropical neuromyelopathy (T. N. M.) was progressively elaborated in tropical areas. This disorder is constituted by three main clinical syndromes (e.g.: polyneuropathy, spastic paraplegia, ataxia). Abnormal clinical, electrophysiological and pathological features, observed in all clinical forms argue in favor of a diffuse pathobiological process of the nervous system. The association with positive HTLV-1 serology, has recently induced a great interest for the spastic forms of T. N. M. Tropical spastic paraplegia tend to be individualised. This attitude differs from the global concept of T. N. M. which allows gathering similar clinical syndromes. This T. N. M. group should be kept intact until the discovery of new aetiology. Toxic (manioc, lathyrism) or deficiency (hypovitaminosis, malabsorption) causes are incriminated. Otherwise aetiology are unknown.
Source: Medline 88327978; Reprinted with permission Copyright 1988 Masson S.A. Paris, France
Ataxia etiology/ Muscle Spasticity/ HTLV Infections complications/ Nervous system diseases etiology/ Paraplegia etiology/ Ataxia/ Australia Deficiency/ France/ HTLV/ Infection/ Lathyrism/ Lathyrism complications/ Lathyrism etiology/ Lathyrism viral infection/ Malabsorption Muscles/ Nervous system/ Neurology/ Paraplegia/ Spasticity/ Spastic paraplegia/ Syndrome/ Tropics/ Nervous system diseases.

Hugon, J.; Ludolph, A. C.; Roy, D. N.; Schaumburg, H. H., and Spencer, P. S. (1988). **Studies on the etiology and pathogenesis of motor neuron diseases. II. Clinical and electrophysiologic features of pyramidal dysfunction in macaques fed Lathyrus sativus and IDPN.** Neurology **38** (3):435-442 (author affiliation: Department of Neuroscience, Albert Einstein College of Medicine, Bronx, NY 10461)

A primate model of lathyrism has been produced in well-nourished male cynomolgus monkeys chronically fed a fortified diet composed of Lathyrus sativus (chickling or grass pea) and given daily per os an alcoholic extract of this legume. Animals given a diet of non-neurotoxic Cicer arietinum (chick pea) cross-matched with the nutritional properties of the experimental diet served as controls. Another group of animals received the same diet and oral doses of beta, beta'-iminodipropionitrile (IDPN), a reference compound that has been termed an 'experimental neurolathyrogen.' Monkeys fed Lathyrus developed clinical and electrophysiologic evidence of corticospinal deficits after 3 to 10 months of feeding. Animals administered IDPN showed clinical and/or electrophysiologic changes in the PNS and CNS motor and sensory pathways, and signs of cerebellar dysfunction. Since the two primate disorders are separable on clinical and electrophysiologic grounds, further use of the term 'experimental neurolathyrogen' to describe the neurotoxic properties of IDPN seems inappropriate. These findings demonstrate the feasibility of developing a model of early human lathyrism in adequately nourished nonhuman primates.
Source: 88157140
Electrophysiology/ Lathyrism physiopathology/ Macaca fascicularis/ Motor Activity drug effects/ Motor Activity physiology/ Muscles physiopathology/ Neuromuscular Diseases physiopathology/ Diet/ Legumes/ Motor Neurons/ Neuromuscular Diseases etiology/ Nitriles poisoning/ Pyramidal Tracts physiopathology/ Lathyrism primate model/ Neurology/ Lathyrus sativus/ Central Nervous system/ Chickens/ Cicer arietinum/ Drugs/ Feeding/ Lathyrism/ Lathyrism animals/ Lathyrism etiology/ Lathyrism motor neurons/ Macaca/ Primates/ Males/ Humans Models/ Motor neurons/ Muscles/ Nervous system/ Neuromuscular/ Neurons/ Neurotoxins/ Nitriles/ Physiology not plant/ Primate model lathyrism/ Pyramidal tract.

Lambein, F. (1988). **Chemistry and biochemistry of Lathyrus sativus**. Presented at the Conference on Lathyrus Sativus and Eradication of Lathyrism. 2-6 May 1986, London, U.K. (Ciba Foundation London.)
Lathyrus sativus chemistry/ Lathyrus sativus biochemistry/ Biochemistry L. sativus/ Chemistry L. sativus/ Phytochemistry L. sativus/ Lathyrus sativus/ Chemistry/ Lathyrism/ Lathyrism Biochemistry/ Phytochemistry.

Lowgren, M. (1988) **Studies on protein quality in legumes with special reference to factors interfering with protein utilisation and digestibility of brown beans (Phaseolus vulgaris L.)** [FILDR thesis]. Uppsala: University of Uppsala, Sweden, 46 pp.
Legumes, which contribute about 20% of the daily protein needs of an adult, contain a number antinutritional substances. The thesis deals with the effect of the antinutritional factors lectins (haemagglutinins), trypsin inhibitors and tannins on the digestibility and utilisation of proteins in legumes, especially brown beans (Phaseolus vulgaris L.) and the effect of processing e.g. soaking, heat treatment and sprouting The complementary effect of proteins from the lathyrism causing legume khesari dhal (Lathyrus sativus) in cereal-based weaning diets resulted in high true digestibility (TD). The antinutritional substances lectins and trypsin inhibitors, were inactivated when the temperature reached above 80$\sp\circ$C during boiling as well as during slow cooking of brown beans. Soaking had no effect on the biological value (BV), TD or net protein utilisation (NPU) of yellow peas (Pisum sativum sens. ampl. (L.) Govorov), soybeans (Glycine max (L.) Merr) or brown beans when evaluated on rats. Heat treatment improved BV, TD and NPU in soybeans and brown beans but not in yellow peas. Sulphur amino acid supplementation improved the BV and NPU in raw yellow peas and soybeans The digestibility of brown bean and casein based diets decreased when lectins and hull, which contain tannins, were added Brown beans sprouted for 10 d, showed gradually decreasing haemagglutinating and trypsin inhibitor activities, to approximately 10% of the original activity. This implies that high activities remain after 4 d, which is a common sprouting time. However, sprouting of chick peas (Cicer arietinum L.) and mung beans (Vigna radiata (L.)), both containing low levels of antinutrients, did not improve BV, TD and NPU.
Antinutritional factors heat treatment/ Antinutritional factors sprouting/ Lathyrus sativus nutritive value/ Nutritive value L. sativus/ Lectin Nutritional value/ Antinutritional factors/ Trypsin inhibitor/ Protease inhibitor/ Polyphenols/ Tannins/ Lathyrus sativus/ Amino acids/ Chickens Cicer arietinum/ Cookery/ Dhal/ Diet/ Digestibility/ Glycine max/ Heat/ Heat treatment/ Khesari/ Lathyrism/ Lathyrism rats/ Vigna radiata Phaseolus vulgaris/ Pisum sativum/ Processing/ Protein/ Protein quality/ Quality/ Rats/ Rodents/ Soaking/ Sulfur/ Sulfur amino acids/ Sweden Temperature/ Uppsala/ Utilisation/ Vigna.

Maru, M.; Getahun, A., and Hoshna, S. (1988). **Prevalence of paralytic poliomyelitis in rural and urban populations in Ethiopia: report of a house to house survey.** American Journal of Tropical Medicine and Hygiene **38** (3):633-635 (author affiliation: Gondar College of Medical Sciences, Gondar Regional Health Department, Ethiopia)
A house-to-house survey was carried out to determine the prevalence of poliomyelitis. During the survey 37,219 households were visited and 17,941 children 5-9 years old were found. Of 231 lame children, lameness compatible with paralytic poliomyelitis was found in 131, of these 91% had their condition before the age of 3 years. Nineteen percent needed a stick support for walking while 12% were unable to walk even with support. This problem was more common in rural populations. The prevalence of paralytic poliomyelitis was 7.3/1,000 children 5-9 years old.

Source: Medline 90365114; Reprinted with permission Copyright 1988 American Journal of Tropical Medicine and Hygiene
Cerebral Palsy complications/ Child/ Ethiopia epidemiology/ Lathyrism complications/ Paralysis congenital/ Paralysis etiology/ Poliomyelitis complications/ Prevalence/ Rural Population/ Urban Population/ Wounds and Injuries complications/ Paralysis epidemiology/ Poliomyelitis epidemiology/ Age/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ Lathyrism epidemiology/ Lathyrism Ethiopia/ Lathyrism etiology/ Humans Paralysis/ Population/ Reports/ Rural/ Surveys/ Tropical medicine/ Tropics.

Roy, D. N. (1988). **The neurotoxic disease lathyrism**. National Medical Journal of India **1**:70-80
Lathyrism review/ Neurology/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Neurotoxins/ Review.

Ryberg, B.; Blomberg, J., and Klasse, P. J. (1988). **Tropical spastic paraparesis associated with human T-lymphotropic virus type 1 in an East African naturalised in Sweden**. British Medical Journal **195**:1380
Source: ref ex Tekle-Haimanot (1989)
Lathyrism related/ HTLV/ Virology/ Lathyrism/ Lathyrism viral infection/ Humans/ Spasticity/ Spastic paraparesis/ Sweden/ Tropics.

Singh, N. K. (1988). **Lathyrism - a spreading malaise**. India Today **13** (March 31):179-181
Source: ref ex Lal and Swarup (1989)
Lathyrism India/ India lathyrism/ India/ Lathyrism.

Valdivieso, R.; Quirce, S., and Sainz, T. (1988). **Bronchial asthma caused by Lathyrus sativus flour.** Allergy **43** (7):536-539 (author affiliation: Servico de Alergia, Hospital Ramon y Cajal, Madrid, Spain)
A 10-year-old child with asthmatic attacks related to Lathyrus sativus flour inhalation was studied in our department. Skin test and specific bronchial provocation challenge were positive. Specific IgE antibodies to Lathyrus sativus flour was demonstrated by indirect enzyme immunoassay. We suggest that our patient's allergic symptoms were due to the development of Type I allergic reactivity to L. sativus antigens.
Source: Medline 89164709; Reprinted with permission Copyright 1988 Munksgaard International Publishers Ltd., Copenhagen
Lathyrus sativus bronchial asthma/ Bronchial Provocation Tests asthma L. sativus/ Immunoenzyme Techniques/ Lathyrism etiology/ Skin Tests Asthma etiology/ Hypersensitivity Immediate/ Legumes adverse effects/ Lathyrus sativus/ Lathyrism symptoms/ Allergy/ Antibodies/ Antigens Asthma/ Child/ Enzymes/ Flour/ Immunology/ Lathyrism/ Lathyrism Spain/ Humans/ Skin/ Spain/ Spain L. sativus/ Symptoms lathyrism.

Abegaz, B. M.; Kebede, N., and Asmelash, S. (1989). **HPLC analysis of beta-N-oxalylamino-L-alanine, the neurotoxin in the legume Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 128-132. (author affiliation: Department of Chemistry, Addis Ababa University, P.O.Box 1176, Addis Ababa, Ethiopia).
A method has been developed, using high performance liquid chromatography, for the analysis of beta-N-oxalyl-L-alanine (BOAA), the neurotoxic substance found in the legume Lathyrus sativus. Derivatization is not employed. It is possible to detect BOAA in the extract of one seed of L. sativus using this method. We have also been able to detect another neurotoxic component, beta-N-methylamino-L-alanine (BMAA) from the seeds of Cycas circinalis. 13C NMR data has also been generated for both compounds.
Source: reprintDE
Chemistry/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Chromatography/ Cycas/ Ethiopia/ HPLC HTLV/ Lathyrism Ethiopia/ Lathyrism viral infection/ Neurotoxins/ NMR/ ODAP/ ODAP analysis/ Seed/ reprint.

Barat, G. K.; Ghose, C., and Singh, J. (1989). **Methods for the estimation of BOAA**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 122-127.
Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ ODAP/ reprint.

Bashir, M. (1989). **Status of Lathyrus sativus in Pakistan**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 175-178.
Source: reprintDE
Pakistan/ INILSEL/ Pakistan L sativus/ Lathyrus sativus Pakistan/ Lathyrus sativus/ reprint.

Bekele, A. (1989). **Nutritional situation in Ethiopia: Potential for Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 191-197.

Source: reprintDE
INILSEL/ Lathyrus sativus human consumption/ Nutrition L sativus/ Ethiopia nutrition/ Ethiopia L sativus/ Lathyrus sativus Ethiopia Lathyrus sativus/ Ethiopia/ Human consumption/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism nutrition/ Humans/ Nutrition/ reprint.

Bell, E. A. (1989). **Lathyrus neurotoxin: History and overview**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 86-88.
Source: reprintDE
INILSEL/ Lathyrus toxicity review/ Review Lathyrus toxins/ Antinutritional factors/ Lathyrus sativus/ History/ Lathyrism/ Lathyrism history Lathyrism review/ Lathyrus toxicity/ Neurotoxins/ Review/ Toxicity L. sativus/ Toxicity/ Toxin/ reprint.

Bharati, M. P. and Neupane, R. K. (1989). **Lathyrus sativus cultivation and screening of germplasm in Nepal**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 159-167.
Source: reprintDE
INILSEL/ Lathyrus sativus production/ Lathyrus sativus cultivation/ Lathyrus sativus Nepal/ Nepal L sativus production/ Genetic resources L sativus Nepal/ Lathyrus sativus/ Agriculture/ Genetic resources/ Cultivation/ Nepal/ Screening/ reprint.

Bridges, R. J.; Kadri, M. M.; Monagham, D. T.; Nunn, P. B.; Watkins, J. C., and Cotman, C. W. (1989). **Inhibition of 3H-AMPA binding by the excitotoxin beta-oxaly-L-alpha,beta-diaminopropionic acid**. European Journal of Pharmacology **145**:357-359
ODAP toxicity/ Biochemistry lathyrism/ AMPA receptors/ Lathyrism/ Lathyrism Biochemistry/ Lathyrism ODAP toxicity/ ODAP/ Receptors Toxicity ODAP/ Toxicity.

Briggs, C. J. (1989). **Analysis of beta-N-Oxalylamino-L-alanine (BOAA)**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 109-121.
Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ ODAP/ reprint.

Campbell, C. G. (1989). **Improvement of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 139-146.
Source: reprintDE
INILSEL/ Lathyrus sativus improvement/ Lathyrus sativus development/ Lathyrus sativus/ reprint.

Campbell, C. G. (1989). **World germplasm resources of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 179-182.
Source: reprintDE
INILSEL/ Lathyrus sativus germplasm/ Genetic resources L sativus/ Lathyrus sativus/ Agriculture/ Genetic resources/ reprint.

Combes, D.; Delbos, M., and Regnault-Roger, C. (1989). **Genetic Resources of Lathyrus sativus in France**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 183-190.
Source: reprintDE
INILSEL/ France L. sativus/ Genetic resources L. sativus/ Lathyrus sativus/ Agriculture/ Genetic resources/ France/ reprint.

Debela, S. (1989). **Brief remarks on grass pea production in Ethiopia**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 147-151.
Source: reprintDE
INILSEL/ Lathyrus sativus production/ Ethiopia L. sativus production/ Lathyrus sativus/ Ethiopia/ Lathyrism Ethiopia/ reprint.

Dwivedi, M. P. (1989). **Epidemiological aspects of lathyrism in India**. Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the**

Improvement of Lathyrus sativus and the eradication of Lathyrism, New York: Third World Medical Foundation, pp. 1-16.
Source: reprintDE
INILSEL/ Lathyrism epidemiology/ Lathyrism India/ India lathyrism/ Lathyrus sativus/ Epidemiology lathyrism/ India/ India L. sativus Lathyrism/ reprint.

Hang, Y. D. (1989). **Post-production methods of vitamin supplementation of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 205-210.
Source: reprintDE
INILSEL/ Post harvest processing L. sativus/ Lathyrus sativus fermentation/ Lathyrus sativus/ Fermentation/ Lathyrism/ Postharvest/ Processing Vitamins/ reprint.

Haque, A. and Mannan, M. A. (1989). **The problem of lathyrism in Bangladesh**. Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 27-35.
Source: reprintDE
INILSEL/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrus sativus/ Bangladesh/ Lathyrism/ reprint.

Jayaraman, K. S. (1989). **Neurolathyrism remains a threat in India.** Nature **339** (6225):495
Source: Medline 89281699
India/ Lathyrism ethnology/ Nervous system diseases ethnology/ Neurology/ India lathyrism/ Lathyrism/ Lathyrism India/ Nervous system Neurolathyrism/ Nervous system diseases.

Kaul, A. K. (1989). **Future strategy for the collection, characterization, storage and utilization of Lathyrus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 188-190.
Source: reprintDE
INILSEL/ Genetic resources Lathyrus/ Lathyrus sativus germplasm/ Lathyrus sativus/ Agriculture/ Genetic resources/ Storage/ Strategy/ reprint.

Kaul, A. K.; Hamid, M. A., and Akanda, R. U. (1989). **An agro-economic survey of two lathyrism-prone areas in Bangladesh**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 41-54.
Source: reprintDE
INILSEL/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Lathyrism socioeconomics/ Socioeconomics Bangladesh/ Bangladesh socioeconomics Economics/ Lathyrus sativus/ Bangladesh/ Lathyrism/ Lathyrism economics/ Surveys/ reprint.

Keenoy, P. M.; Urzay Iribarnegaray, C.; Quevedo Arechederra, M. A.; Urtusagasti Orue, G., and Brouard Urquiaga, J. M. (1989). **Latirismo y anestesia: a proposito de un caso. [Lathyrism and anesthesia: apropos of a case (letter)].** Rev Esp Anestesiol Reanim **36** (2):124
Source: Medline 89387799
Middle Age/ Anesthesia General/ Lathyrism physiopathology/ Neuromuscular Blocking Agents/ Age/ Lathyrism/ Neuromuscular.

Kisby, G. E.; Roy, D. N., and Spencer, P. S. (1989). **A sensitive HPLC method for detection of beta-N-oxalylamino-L-alanine in Lathyrus sativus and animal tissue**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 133-138.
Source: reprintDE
INILSEL/ ODAP analysis/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ HPLC/ HTLV/ Lathyrism animals/ Lathyrism viral infection/ ODAP/ Tissue/ reprint.

Lal, M. S. and Swarup, I. (1989). **Socio-economic issues in relation to production and consumption of Lathyrus sativus in India**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 55-60.
Source: reprintDE
INILSEL/ Lathyrus sativus production/ Lathyrus sativus cultivation/ Lathyrus sativus socioeconomics/ Socioeconomics L. sativus/ Economics Lathyrus sativus/ Cultivation/ India/ India L. sativus/ India L. sativus consumption/ India L. sativus production/ India lathyrism/ Lathyrism Lathyrism economics/ Lathyrism India/ reprint.

Lambein, F. (1989). **Chemistry and biochemistry of Lathyrus sativus**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 61-75.
Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ Lathyrus sativus Isoxazolin-5-one/ Biochemistry L. sativus/ Chemistry L. sativus/ NPAA L. sativus Lathyrus sativus/ Isoxazolin-5-one/ Chemistry/ Lathyrism/ Lathyrism Biochemistry/ Lathyrus toxicity/ NPAA/ NPAA chemistry/ Toxicity L. sativus/ Toxicity/ reprint.

Nunn, P. B. (1989). **Lathyrus sativus toxins: Identification and possible mechanisms**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 89-96.
Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Mechanisms toxicity/ Review L. sativus toxicity Antinutritional factors/ Lathyrus sativus/ Lathyrism/ Lathyrism mechanisms/ Lathyrism review/ Lathyrus toxicity/ Review/ Toxicity/ Toxin reprint.

Palmer, V. S.; Kaul, A. K., and Spencer, P. S. (1989). **International network for the improvement of Lathyrus sativus and the eradication of lathyrism (INILSEL): a TWMRF initiative**. In: Spencer, P. S. and Fenton, M. B. (Ed). **The grass pea: Threat and promise Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 218-233.
Source: reprintDE
INILSEL/ Manifesto/ Lathyrus sativus research funding/ Lathyrus sativus/ reprint.

Pushpamma, P. (1989). **Post-production processing of Lathyrus sativus in India**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 198-204.
Source: reprintDE
INILSEL/ Lathyrus sativus detoxification/ Detoxification L. sativus/ Post harvest processing L. sativus/ India L. sativus/ Lathyrus sativus India Lathyrus sativus/ Detoxification/ India/ India lathyrism/ Lathyrism/ Lathyrism India/ Postharvest/ Processing/ reprint.

Quader, M.; Ahad Miah, M. A.; Wahiduzzaman, M., and Rahman, S. (1989). **Present status of Lathyrus sativus research in Bangladesh**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 152-158.
Source: reprintDE
INILSEL/ Bangladesh L. sativus research/ Lathyrus sativus Bangladesh/ Lathyrus sativus/ Bangladesh/ Lathyrism Bangladesh/ reprint.

Rathod, K. L. (1989). **Status of Lathyrus sativus in India with special reference to Madhya Pradesh**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 168-174.
Source: reprintDE
INILSEL/ India L. sativus/ Lathyrus sativus India/ Lathyrus sativus Madhya Pradesh/ Madhya Pradesh L. sativus/ Lathyrus sativus/ India India Madhya Pradesh/ India lathyrism/ Lathyrism/ Lathyrism India/ Madhya Pradesh/ reprint.

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Source: reprintDE
INILSEL/ Lathyrus sativus research funding/ Lathyrus sativus/ reprint.

Ross, S. M. and Spencer, P. S. (1989). **Beta-N-oxalylamino-L-alanine: Potential mechanisms of neurotoxicity**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 97-108.
Source: reprintDE

INILSEL/ ODAP toxicity/ ODAP toxicity mechanism/ Toxicity L. sativus mechanisms/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Lathyrism/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Mechanisms toxicity/ Neurotoxicity/ ODAP Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ reprint.

Roy, D. N.; Kisby, G. E.; Robertson, R. C., and Spencer, P. S. (1989). **Toxicology of Lathyrus sativus and the neurotoxin BOAA**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 76-85.
Source: reprintDE
INILSEL/ Lathyrus sativus toxicity/ ODAP toxicity/ Amino acid composition L. sativus/ Lathyrus sativus/ Amino acids/ Amino acid composition/ Lathyrism/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Neurotoxins/ ODAP/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity reprint.

(1989). Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation.
Source: reprintDE
INILSEL/ Lathyrus sativus/ reprint.

Tekle Haimanot, R. (1989). **Lathyrism in Ethiopia**. In: Spencer, P. S. and Fenton, M. B. (Eds). **The grass pea: Threat and promise. Proceedings of the International Network for the Improvement of Lathyrus sativus and the eradication of Lathyrism**, New York: Third World Medical Foundation, pp. 36-40.
Source: reprintDE
INILSEL/ Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrus sativus/ Ethiopia/ Lathyrism/ reprint.

Weiss, J. H.; Koh, J.-Y., and Choi, D. W. (1989). **Neurotoxicity of ß-N-methylamino-L-alanine(BMAA) and ß-N-oxalylamino-L-alanine(BOAA) on cultured cortical neurons**. Brain Research **497**:64-71.
Recent studies have implicated the ingestion of the structurally related plant excitotoxins, beta-N-methylamino-L-alanine (BMAA), and beta-N-oxalylamino-L-alanine (BOAA), in the pathogenesis of two human motor system diseases, the amyotrophic lateral sclerosis-Parkinsonism-dementia complex of Guam (Guam ALS-PD), and lathyrism, respectively. We have investigated the toxicity of these amino acids on cultured mouse cortical neurons in the presence of physiological concentrations of bicarbonate (a required toxic cofactor for BMAA neurotoxicity). A 24 h exposure to 10 microM - 3 mM BMAA, or to 300 nM - 100 microM BOAA, induced, concentration-dependent neuronal degeneration without glial damage; the neurotoxic EC50 for BMAA was about 1 mM, and the EC50 for BOAA was about 20 microM. At high concentrations, both compounds destroyed essentially the entire neuronal population. Neurotoxicity also depended on exposure duration, with reduced injury at an exposure time of 1 h, and increased injury at an exposure time of 3 days. Despite the fact that ingestion of BMAA and BOAA both lead to motor system damage, previous studies have suggested that the two excitotoxins act primarily on different glutamate receptor subtypes: BMAA on N-methyl-D-aspartate (NMDA) receptors, and BOAA on non-NMDA receptors. Consistent with these studies, the neurotoxicity of high concentrations of BMAA was substantially attenuated by 1 mM D-amino-5-phosphonovalerate (D-APV), whereas BOAA neurotoxicity was less sensitive to D-APV but was attenuated by 2 mM kynurenate.(ABSTRACT TRUNCATED AT 250 WORDS).
Source: reprintDE; reprinted with permission Copyright 1989 Elsevier Science B.V., Amsterdam, Netherlands
NPAA/ ODAP bioassay/ ODAP cortical neuron bioassay/ Lathyrus sativus toxicity/ Rodents/ Neurology/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Amino acids/ Amino acids toxicity/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Glutamates/ Glutamates receptors/ Guam/ Heavy metals/ Lathyrism/ Lathyrism Bioassay/ Lathyrus toxicity/ Humans/ Metals/ Mice/ Neurons/ Neurotoxicity/ Neurotoxins/ NMDA/ NPAA rodents/ ODAP/ Population Receptors/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity rodents bioassay/ Toxicity/ reprint.

Acharya, G. P. and Pathak, U. N. (1990). **A pilot study on lathyrism in eastern Terai of Nepal.** Journal of the Institute of Medicine (Nepal) **12** (3):233-239 (author affiliation: Dep. Med., TU Inst. Med. Nepal, Nepal)
A pilot study on Lathyrism in two districts of Eastern Terai of Nepal, Mohatari and Dhanusa, detected eight cases of Lathyrism. The study also collected information on cultivation and consumption pattern of Lathyrus sativus.
Source: Copyright Biological Abstracts (91)
Lathyrism/ Nepal L sativus/ Lathyrus sativus/ Cultivation/ Nepal.

Allen, C. N.; Ross, S. M., and Spencer, P. S. (1990). **Properties of the neurotoxic non-protein amino acids beta-N-methylamino-L-alanine (BMAA) and beta-N-oxalyamino-L-alanine (BOAA), in ALS**. In: Ross, F. C. and Norris, F. H. (Eds). **New Advances in Toxicology and Epidemiology**, London: Smith-Gordon, pp. 49-56.
Source: ref ex Roy (pers. comm.)

ODAP toxicity/ Lathyrism/ NPAA toxicity/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ Epidemiology lathyrism/ Lathyrism epidemiology/ Lathyrism ODAP toxicity/ Neurotoxins/ NPAA/ ODAP/ Protein/ Toxicity ODAP/ Toxicity.

Meldrum, B. S. and Garthwaite, J. (1990). **Excitatory amino acid neurotoxicity and neurodegenerative disease**. Trends in Pharmacological Sciences **11**:379-387
Lathyrism/ ODAP/ Neurodegenerative disease/ Review/ Neurology/ Amino acids/ Amino acids reviews/ Excitatory amino acid/ Lathyrism review/ Neurodegenerative/ Neurotoxicity.

Murphy, T. H.; Schnaar, R. L., and Coyle, J. T. (1990). **Immature cortical neurons are uniquely sensitive to glutamate toxicity by inhibition of cystine uptake**. FASEB J **4**:1624-1633
Sulfur/ Lathyrism/ ODAP uptake/ Sulfur amino acid transport/ Toxicity/ Amino acids/ Cystine/ Glutamates/ Immaturity/ Neurology/ Neurons ODAP/ Sulfur amino acids/ Toxicity ODAP.

Nicolls, D. G. and Attwell, D. (1990). **The release and uptake of excitatory amino acids**. Trends in Pharmacological Sciences **11**:462-468
Lathyrism/ ODAP/ Neuroexcitatory amino acid uptake/ Neuroexcitatory amino acid release/ Amino acids/ Excitatory amino acid Neuroexcitatory.

Roy, B. C.; Naved, A. F.; Chowdhury, A. K. A., and Yusuf, H. K. M. (1990). **BOAA content of Lathyrus sativus varieties grown in Bangladesh.** Bangladesh Journal of Scientific Research **8** (1):49-58 (author affiliation: Dhaka Univ. (Bangladesh). Dept. of Biochemistry)
The toxin (BOAA, beta-N3 oxalylamino-L-alanine) contents of Lathyrus sativus (khesari) grown in different regions of Bangladesh (from Chittagong to Dinajpur and from Sylhet to Khulna) were measured by a standardized calorimetric method. The major varieties grown in Barisal, Charbadna, Jamalpur and Pahartali contained 486, 837, 540 and 527 mg BOAA per 100 g dried seed. Other values ranged from 552 mg/100 g at Bola and 570 mg/100 g at Khulna to 905 mg/100 g at Dinajpur and 973 mg/100 g at Rangpur. However, in Faridpur, the neighbouring district of Barisal or Khulna, the seed had a rather high value of 848 mg/100 g; on the other hand, in the Northern district of Bogra, which is near to Rangpur, the BOAA content was only 628 mg/100 g. In Rajshahi and Kushtia (regions known as the lathyrism pocket), the BOAA contents were 686 and 636 mg/100 g, respectively, values intermediate between those observed in seeds grown in Bola and Khulna, or Rangpur and Dinajpur. The data thus indicate that there is no clear-cut correlation between BOAA content of seeds grown in different regions of Bangladesh, nor does there exist any positive correlation between toxin content of Lathyrus seeds and the prevalence of lathyrism.
Source: CODIS 91-056470
ODAP L. sativus/ Lathyrus sativus ODAP/ Lathyrus sativus germplasm/ Lathyrus sativus Bangladesh/ Bangladesh L. sativus/ Lathyrism epidemiology/ Epidemiology lathyrism/ Biochemistry/ Lathyrus sativus/ Agriculture/ Genetic resources/ Beta Alanine analogs and derivatives Bangladesh/ Khesari/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism Biochemistry/ ODAP/ Prevalence/ Seed/ Toxin/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Genetic resources L. sativus.

Tekle Haimanot, R.; Abebe, M.; Gebre-Mariam, A.; Forsgren, L.; Holmgren, G.; Heijbel, J., and Ekstedt, J. (1990). **Community-based study of neurological disorders in rural central Ethiopia**. Neuroepidemiology **9**:263-277
Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrism epidemiology/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ Rural.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kalissa, A.; Alemu, T.; Zein, Z. A., and Spencer, P. S. (1990). **Lathyrism in rural Northwestern Ethiopia: a highly prevalent neurotoxic disorder.** International Journal of Epidemiology **19** (3):664-672 (author affiliation: Faculty of Medicine, PO Box 4147, Addis Ababa University, Ethiopia)
Lathyrism is a disorder of the central motor system, induced by heavy consumption of the grass-pea, Lathyrus sativus, an environmentally tolerant legume containing a neurotoxic excitatory amino acid. A complete door-to-door resurvey of the Dembia and Fogera regions of northwestern Ethiopia, areas endemic for lathyrism, revealed an estimated mean disease prevalence of 0.6%-2.9%. Most patients developed the disease in the epidemic of 1976/77, although new cases appear to have occurred with an estimated mean annual incidence of 1.7:10 000. Production and consumption of grass-pea is increasing in Ethiopia, making attempts to develop special strains to prevent lathyrism increasingly important.
Source: Copyright CAB Abstracts (90-91) R848142
East Africa/ Grain legumes/ Food consumption/ Ethiopia lathyrism/ Nervous system diseases/ Neurology/ Lathyrus sativus/ Africa/ Amino acids Endemic/ Epidemiology lathyrism/ Excitatory amino acid/ Food/ Pulses/ Lathyrism Ethiopia/ Incidence/ Lathyrism/ Lathyrism epidemiology Humans/ Nervous system/ Neurotoxins/ Prevalence/ Rural/ Strains/ Tolerance.

Young, A. B. and Fagg, G. E. (1990). **Excitatory amino acid receptors in the brain: membrane binding and receptor autoradiographic approaches**. Trends in Pharmacological Sciences **11**:126-133
Brain excitatory neuroreceptors/ Lathyrism/ ODAP receptors/ Neurology/ Amino acids/ Brain/ Excitatory amino acid/ Membranes/ ODAP Receptors.

Bridges, R. J.; Hatalski, C.; Shim, S. N., and Nunn, P. B. (1991). **Gliotoxic properties of the Lathyrus excitotoxin beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (beta L ODAP).** Brain Research **561** (2):262-268 (author affiliation: Department of Neurology, Irvine Research Unit on Brain Aging, University of California 92717 USA)

beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid (beta-L-ODAP) is an excitatory amino acid agonist found in the seeds of Lathyrus sativus that is believed to be the major causative agent in the pathology of human lathyrism. We have found that in addition to its previously recognized neurotoxic properties, beta-L-ODAP is also gliotoxic. When added to cultures of neonatal rat astrocytes, beta-L-ODAP induced a series of morphological changes (e.g., extensive vacuole formation, pale and swollen nuclei with obvious nucleoli, and cellular swelling) that led to the eventual lysis of the glial cells. If the beta-L-ODAP was removed prior to the lysis of the astrocytes, many of the early morphological changes appeared to be reversible. When quantitated by a loss of the lactate dehydrogenase activity, beta-L-ODAP lysed the astrocytes with an LD50 of 2.1 +/- 0.2 mM following 48 h of exposure. Lower concentrations of beta-L-ODAP were found to be more toxic if the duration of the exposure was increased. The results suggest that the overall impact of the toxin on the CNS may represent the cumulative action of beta-L-ODAP at a number of distinct points on both neurons and astrocytes. The potential that these multiple sites of action may affect the normal regulation of extracellular glutamate and, consequently, disturb the balance between its normal and pathological roles is discussed.

Source: Medline 92200206; Reprinted with permission Copyright 1991 Elsevier Science B.V., Amsterdam, Netherlands

Lathyrus sativus ODAP/ Animals Newborn/ Astrocytes drug effects/ Cell Survival drug effects/ Cells Cultured/ Molecular Structure/ Rats Structure Activity Relationship/ Amino acids Diamino pharmacology/ Astrocytes cytology/ Cerebral Cortex cytology/ Neurotoxins pharmacology/ Rodents/ ODAP/ NPAA/ ODAP toxicity/ Toxicity ODAP/ Neurology/ Lathyrus sativus/ Amino acids/ Astrocytes/ Brain California/ Central Nervous system/ Cerebral Cortex/ Cytology/ Drugs/ Excitatory amino acid/ Glutamates/ Lactate dehydrogenase/ Lactate Lathyrism/ Lathyrism animals/ Lathyrism ODAP toxicity/ Lathyrism pathology/ Lathyrism rats/ Lathyrus toxicity/ Humans/ Molecular Nervous system/ Neurons/ Neurotoxins/ NPAA rodents/ Nuclei/ Regulation/ Seed/ Survival/ Toxicity L. sativus/ Toxicity/ Toxin/ USA.

Deshpande, S. S. and Sathe, S. K. (1991). **Toxicants in plants**. In: Sharma, R. P. and Salunkhe, D. K. (Eds). **Mycotoxins and phytoalexins**, Boca Raton: CRC Press, pp. 671-730.

Naturally occurring antinutritional and toxic factors from important plant food sources are discussed. No attempt has been made to cover all known natural toxic substances from plants, and this review covers certain evolutionary, structural, biochemical, technological, nutritional and toxicological aspects of the most important antinutritional factors occurring in the human food chain. The main headings are: carbohydrates, proteins and amino acids, lipids and fatty acids, minerals, vitamins, antivitamins, proteinase inhibitors, amylase inhibitors, lipase inhibitors, lectins (phytohaemagglutinins), phytate, tannins (polyphenols), cyanogenic glycosides, glucosinolates, favism, lathyrism, toxic amino acids, saponins, steroidal alkaloids of potato, allergens, gossypol, safrole, oestrogens, oxalates, removal of antinutrients.

Source: Copyright CAB Abstracts (92) V682150

Toxicity/ Toxic substances/ Poisonous plants/ Plants/ Lectin/ Antinutritional factors/ Amylase inhibitor/ Polyphenols/ Tannins/ Phytoalexins Saponins/ Glycosides/ Mycotoxins/ Alkaloids/ Amylase/ Amino acids/ Amino acids reviews/ Carbohydrates/ Evolution/ Fats/ Fatty acids Favism/ Food/ HCN/ Lathyrism mycotoxins/ Lathyrism review/ Lipids/ Humans/ Mineral/ Oxalates/ Phytates/ Protein/ Review/ Toxic amino acids/ Vitamins.

Haque, A.; Hossain, M., and Wouters, G. (1991). **Epidemiological and clinical study of lathyrism in Bangladesh: preliminary report.** Bangladesh Journal of Neuroscience **7** (2):60-71

Source: Lambein_95_5

Bangladesh lathyrism/ Lathyrism Bangladesh/ Lathyrism epidemiology/ Neurology/ Bangladesh/ Epidemiology lathyrism/ Lathyrism/ Reports.

Hussain, M. (1991). **Future of Khesari cultivation in Bangladesh**. In: Kumar, J.; Sahni, B. B., and Usha Raman (Eds). **Advances in pulses research in Bangladesh. Proceedings of the second national workshop on pulses, 6-8 June 1989, Joydebpur, Bangladesh**, Patancheru, India: ICRISAT, pp. 183-189. (author affiliation: Bangladesh Agricultural Research Institute, Mymensingh, Bangladesh).

Khesari (Lathyrus sativus L.) in the most important pulse crop of Bangladesh. A strong epidemiological association is known to exist between human consumption of Khesari and the incidence of lathyrism. A toxin in its seed called -N-axalyl-L-, -diaminopropionic acid (ODAP) is believed to be the causative principle. About 6000 patients are affected by lathyrism in this country. Often malnourished young males are the victims. The area under khesari cultivation remains high because of its drought resistance, its minimal managerial requirement, and its protein-rich seeds. Of all the processing procedures, lime water is reported to remove the toxin from the seeds to a great extent. Vitamin C is reported to protect consumers from lathyrism. Attempts to develop a toxin-free cultivar have so far proved unsuccessful. Oxalyl derivatives of some amino acids as well as isoxazolinone dervatives were found in the synthesis of ODAP but its biosynthetic pathway is still not understood. This may in part offer an explanation for the unsuccessful search for toxin-free cultivars.

The search should continue for low-toxin lines with high seed yield, and for easy, effective procedures to remove the toxin before the seeds are consumed. Studies on the relationship between drought and salinity resistance and the -N-axalyl aminoalamine (BOAA) content may be carried out.
Source: P292937 ; reprintDE
Grain legumes/ Evaluation/ Bangladesh/ Composition/ ODAP/ Agronomy/ Forage/ Salinity/ Lathyrus sativus/ Isoxazolin-5-one/ Agriculture Amino acids/ Ascorbic acid/ Vitamin C/ Climate/ Cultivars/ Cultivation/ Drought/ Drought resistance/ Fodder/ Pulses/ Grain legumes Bangladesh/ Grain legumes India/ Human consumption/ Incidence/ India/ India L. sativus/ India L. sativus consumption/ India lathyrism Khesari/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism vitamin C/ Lathyrus sativus agronomy/ Lime/ Males/ Humans Processing/ Protein/ Resistance/ Seed/ Seed yield/ Toxin/ Vitamins/ Water/ Yield/ Yield fodder/ Yield L. sativus/ reprint.

Jubete, F. F. (1991). **Los Titarros. El cultivo de Lathyrus en Castilla y Leon. [Cultivation of Lathyrus sativus and L. cicera in Castilla and Leon, Spain)**. Junta de Castilla y Leon. Consejera de Agricultura y Ganaderia, 175 pp Coleccion de Estudios Agrarios No. 1. ISBN: 84-7939-011-5 (author affiliation: Prof. Fernando Franco Jubete, Esculea Tecnica Superior de Ingenierias Agrarias, Universidad de Valldolid, Avda. de Madrid, 57, ph: (979) 72 90 48 - 72 90 69, 34071 Palencia, Spain).
Titarro is the Spanish name for Lathyrus cicera. This publication is based on a study (1984 -1989) for a doctoral dissertation with the title 'Iniciacion a la seleccion de Lathyrus cicera L. en la provincia de Palencia' (1990) and provides a comprehensive treatise of Lathyrus spp. in the regions of Castilla and Leon, Spain, with particular emphasis on crop development of L. cicera, incl. botany, agronomy, genetic resources and their evaluation, breeding. It is interesting to note that cultivated L. cicera is frequently a mixture (semilla de comuna) of Vicia ervilia (yeros, ca 10%), V. sativa (vezas ca 3 %), barley (ca 21%) and other impurities (ca 13%). Date is not given in the publication.
Source: DE_96_9; reprintDE
Monograph L. cicera/ Lathyrus cicera monograph/ Lathyrus cicera Spain/ Spain L. cicera/ Spain Lathyrus spp/ Lathyrus spp Spain/ Vicia ervilia Vicia sativa/ Legume mixtures/ Lathyrism Spain/ Spain Lathyrism/ Mixtures communal/ Communal mixtures/ Semillas de comuna/ Traditional names/ Cultivation L. cicera/ Lathyrus cicera agronomy/ Lathyrus cicera climatic factors/ Lathyrus cicera cultivation/ Lathyrus cicera distribution/ Lathyrus cicera fodder value/ Lathyrus cicera feeding/ Lathyrus cicera intercropping/ Lathyrus cicera L./ Lathyrus cicera phenology/ Forage/ Lathyrus sativus/ Lathyrus cicera/ Agriculture/ Genetic resources/ Agronomy mixtures/ Hordeum/ Climate/ Cultivation/ Dissertations/ Distribution plants/ Evaluation genetic resources/ Feeding/ Fodder/ Intercropping/ Lathyrism/ Lathyrism L. cicera/ Lathyrus sativus agronomy/ Lathyrus spp/ Mixtures crops/ Monograph/ Phenology/ Landrace mixtures/ Spain/ Spain L. sativus/ Traditional names/ Vicia/ Genetic resources evaluation/ reprint.

Spencer, P. S.; Allen, C. N.; Kisby, G. E.; Ludolph, A. C.; Ross, S. M., and Roy, D. N. (1991). **Lathyrism and western Pacific amyotrophic lateral sclerosis: etiology of short and long latency motor system disorders.** Adv Neurol **56**:287-299 (author affiliation: Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University, Portland 97201)
Source: Medline 91306771
beta Alanine analogs and derivatives/ Amyotrophic Lateral Sclerosis chemically induced/ Amyotrophic Lateral Sclerosis physiopathology Lathyrism chemically induced/ Lathyrism physiopathology/ Nerve Degeneration/ Nervous system diseases chemically induced/ Nervous system diseases physiopathology/ Neuromuscular Diseases chemically induced/ Neuromuscular Diseases physiopathology/ Neurons drug effects/ Plants Toxicity/ Amyotrophic Lateral Sclerosis etiology/ Lathyrism etiology/ Neuromuscular Diseases etiology/ Neurology/ Beta Alanine analogs and derivatives/ Amyotrophic lateral sclerosis/ Drugs/ Environment/ Lathyrism/ Lathyrism nerve degeneration/ Nerves/ Nervous system Neuromuscular/ Neurons/ Oregon/ Toxicity/ Nervous system diseases.

Wadia, N. H. (1991). **Unusual degenerative and environmental diseases seen in India.** Mitteilungen Der Osterreichischen Gesellschaft Fur Tropenmedizin Und Parasitologie **13**:59-69 (author affiliation: Jaslok Hospital and Research Centre, Bombay, India)
Malnutrition and its effect on the nervous system and toxicity caused by consuming the legume Lathyrus sativus, leading to lathyrism, as seen in India is reviewed.
Source: Copyright CAB Abstracts (94-94.6) N583292
Deficiency diseases/ Lathyrus sativus malnutrition/ Malnutrition deficiency diseases/ Nervous system diseases malnutrition/ Malnutrition India Lathyrism/ Toxicity/ Famine/ Malnutrition/ Lathyrus sativus/ Deficiency/ Environment/ India/ India L. sativus/ India malnutrition/ India lathyrism/ Lathyrism India/ Lathyrus toxicity/ Humans/ Nervous system/ Neurology/ Toxicity L. sativus/ Nervous system diseases.

Campbell, C. G. (1992). **Genotypic characters for reduced neurotoxin content in Lathyrus sativus**. Lathyrus and Lathyrism Newsletter **4**:9-10
Source: reprintDE
Lathyrus sativus genetics/ Genetics L sativus/ Breeding/ ODAP genetics/ Genetics ODAP/ Lathyrus sativus/ Genetics/ Neurotoxins/ ODAP reprint.

Drory, V. E.; Rabey, M. J., and Cohn, D. F. (1992). **Electrophysiologic features in patients with chronic neurolathyrism.** Acta Neurologica Scandinavica **85** (6):401-403 (author affiliation: Department of Neurology, Tel-Aviv Sourasky Medical Center, Israel)
Neurolathyrism is a toxic nutritional disorder induced by the ingestion of the chick-pea 'Lathyrus sativus' and characterised by a pure motor spastic paraparesis. Eight patients with long-standing disease underwent nerve

conduction and electromyographic studies. Two of them (25%) showed electrophysiological signs of lower motor neuron disease in their lower limbs. Subclinical affection of the anterior horn cells occurs probably more frequently than expected in chronic neurolathyrism.
Source: Medline 92351736; Reprinted with permission Copyright 1992 Munksgaard Publishers, Copenhagen
Aged/ Electromyography/ Lathyrism diagnosis/ Muscles innervation/ Neurologic Examination/ Peripheral Nerve Diseases diagnosis/ Peripheral Nerves physiopathology/ Reaction Time physiology/ Food Poisoning physiopathology/ Lathyrism physiopathology/ Legumes poisoning/ Neural Transmission physiology/ Peripheral Nerve Diseases physiopathology/ Neurology/ Lathyrus sativus/ Palestine/ Age/ Anterior horn/ Chickens Diagnosis/ Food poisoning/ Food/ H Reflex/ Lathyrism/ Lathyrism Aged/ Lathyrism electromyography/ Lathyrism motor neurons/ Lathyrus toxicity/ Motor neurons/ Muscles/ Nerves/ Neural/ Neurolathyrism/ Neurons/ Peripheral/ Physiology not plant/ Reflexes/ Spasticity/ Spastic paraparesis/ Toxicity L. sativus/ Toxicity/ Transmission.

Gopalan, C. (1992). **The contribution of nutrition research to the control of undernutrition: the Indian experience.** Annual Reviews of Nutrition **12**:1-17 (author affiliation: Nutrition Foundation of India, New Delhi)
Since diseases directly related to undernutrition are the major public health problems of India, nutrition research in the country has been largely directed towards elucidating their causes and identifying the most feasible methods for their prevention and control. This effort is an interdisciplinary exercise carried out in the laboratory, the clinic, and the field, with close interaction among biochemists, clinicians, and epidemiologists. Some of the identified solutions have found practical application; but, as in other areas of scientific endeavour, a gap exists between the acquisition of knowledge in the laboratories and its application in the field. Today, thanks to research efforts of the last few decades, we have the knowledge with which most diseases related to undernutrition can be prevented. Unfortunately, however, we do not always have the means of applying this knowledge under real-life conditions in the field. Even so, nutrition research during the last few decades has contributed significantly to the amelioration of undernutrition among poor communities in India.
Source: Medline 92368694
India/ Lathyrism prevention and control/ Nutrition Disorders aetiology/ Pellagra prevention and control/ Protein Energy Malnutrition prevention and control/ Vitamin A Deficiency prevention and control/ Nutrition review/ Nutrition Disorders prevention and control/ Review malnutriton Malnutrition review/ Famine/ Malnutrition/ Carotene/ Deficiency/ Delhi/ Energy/ India malnutrition/ India lathyrism/ Lathyrism/ Lathyrism India/ Lathyrism nutrition/ Lathyrism prevention/ Lathyrism review/ Nutrition/ Nutrition disorders/ Pellagra/ Prevention lathyrism/ Lathyrism prevention/ Protein/ Review/ Vitamin A/ Vitamins.

Khan, J. K.; Lambein, F., and Yusuf, H. K. (1992). **Beta-isoxazolinone-alanine and Lathyrism research - Optimisation of its isolation and purification.** Dhaka University Studies. Part E **7** (1):83-86
The biosynthetic precursor for the neurotoxin ODAP present in Lathyrus sativus (Khesari) is an unstable non-amino acid beta-(isoxazolin-5-on-2-yl) - alanine BIA. A scheme for it's purification was optimised. A three- step procedure leads to a pure crystalline compound.
Source: CGC_95_2 ; reprintDE
ODAP/ Lathyrus sativus/ Isoxazolin-5-one/ Beta Alanine analogs and derivatives/ Amino acids/ Isolation/ Khesari/ Neurotoxins/ Purification reprint.

Krogsgaard, L. P. and Hansen, J. J. (1992). **Naturally occurring excitatory amino acids as neurotoxins and leads in drug design.** Toxicology Letters (Amsterdam) **64-65 sec No**:409-416 (author affiliation: Department of Organic Chemistry, Royal Danish School of Pharmacy, Copenhagen)
The central excitatory neurotransmitter (S)-glutamic acid (Glu) activates at least three types of receptors the NMDA, AMPA, and kainic acid (KAIN) receptors. These receptors mediate the neurotoxicity of a number of naturally-occurring Glu analogues. Thus, domoic acid, a KAIN receptor agonist, has probably been the cause of severe neurologic illness in people who consumed domoic acid poisoned food. beta-N-oxalylaminoalanine (beta-ODAP), an AMPA receptor agonist, has been associated with lathyrism, a spastic paraparesis caused by dietary intake of Lathyrus sativus. The neurotoxic Amanita muscaria constituent ibotenic acid, a nonselective NMDA receptor agonist, has been used as a lead structure for the development of the specific NMDA receptor agonist AMAA, AMPA, and a number of therapeutically interesting AMPA and KAIN receptor agonists.
Source: Medline 93110690, Reprinted with permisssion (1992) Elsevier Science Ireland Ltd.
Alzheimer's Disease etiology/ Drug Design/ Ibotenic Acid pharmacology/ Receptors Glutamate drug effects/ Receptors N Methyl D Aspartate drug effects/ Review/ Neurotoxicity review/ ODAP/ Chemistry/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids reviews/ AMPA receptors/ Aspartic acid/ Diet/ Dietary intake/ Domoic acid/ Drugs/ Excitatory amino acid/ Food/ Glutamates/ Heavy metals/ Ibotenic acid Dietary/ Intake/ Kainic acid/ Lathyrism etiology/ Lathyrism review/ Lathyrus toxicity/ Metals/ Neurotoxicity/ Neurotoxins/ NMDA/ Receptors Spasticity/ Spastic paraparesis/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity.

Rasmussen, M. A.; Foster, J. G., and Allison, M. J. (1992). **Lathyrus sylvestris (flatpea) toxicity in sheep and ruminal metabolism of flatpea neurolathyrogens**. In: James, L. F.; Keeler, R. F.; Bailey, E. M.; Cheeke, P. R., and Hegarty, M. P. (Eds). **Poisonous plants. Proceedings of the Third International Symposium**, Ames: Iowa State University Press, pp. 377-381. (author affiliation: USDA-ARS, PO Box 70, Ames, IA 50010, USA).

Ruminal metabolism of neurolathyrogens may be an important factor in the adaptation of ruminants to the legume flatpea. Initial studies indicated that flatpea lathyrogens were rapidly released after consumption and that animals consuming this legume were at risk of intoxication. Further studies indicated that 17- and 38-day stepwise adaptation periods inadequately protected sheep from flatpea intoxication. Symptoms of intoxication when consumption approached 75% dietary flatpea included muscular tremors, incoordination, seizures and death. Only after prolonged consumption (<4 months) of a nonlethal diet consisting of 50% flatpea did sheep successfully adapt to 100% dietary flatpea which they consumed with no complications. The exchange of rumen contents between alfalfa [lucerne]-fed and flatpea-fed sheep resulted in the formerly tolerant, flatpea-fed animal developing symptoms of lathyrism within 48 h. In contrast, the formerly naive, alfalfa-fed animal subsisted on 100% flatpea for 15 days with no indication of lathyrism. This evidence suggests that adaptation to flatpea is due to alterations in rumen metabolism. The rate of 2,4-diaminobutyric acid (DABA) degradation in rumen contents obtained from both unadapted and adapted sheep ranged between 0.2-0.3 µmol ml/h. The similarity of these degradation rates suggests that although DABA is the predominant lathyrogen in flatpea, other lathyrogenic compounds may be of greater importance in the aetiology of flatpea intoxication and protective adaptation.
Source: Copyright CAB Abstracts (94-94.6) V894450
Leguminosae/ Nervous system diseases/ Rumen microorganisms/ Poisonous plants/ Lathyrus/ Lathyrus sylvestris/ Toxicity/ Sheep/ Ruminants Antinutritional factors/ Adaptation/ Lathyrus tingitanus/ DABA/ Agriculture/ Lathyrism symptoms/ Medicago sativa/ Degradation Detoxification/ Diet/ Dietary/ Lathyrism/ Lathyrism animals/ Lathyrism complications/ Lathyrogens/ Lathyrus sylvestris/ Lathyrus toxicity Medicago/ Metabolism/ Microorganisms/ Muscles/ Nervous system/ Neurology/ Risk/ Rumen/ Symptoms lathyrism/ Tolerance/ Toxicity L. sylvestris/ Toxin/ USA/ USDA.

Shen, L. M.; Orcutt, D. M., and Foster, J. G. (1992). **Influence of polyethylene glycol and aeration method during imbibition on germination and subsequent seedling growth of flatpea (Lathyrus sylvestris).** Seed Science and Technology **20** (3):349-357 (author affiliation: Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA)
L. sylvestris seeds imbibed in media containing polyethylene glycol 8000 (PEG) at concentrations of 0 (water), 25, 35 or 50% (w/v). Imbibition solutions were aerated continuously with ambient air, bubbled with pure oxygen for 3 min every 12 h or were not provided with supplemental oxygen. Seeds were imbibed for 0.5, 1.0, 1.5, 2.5 or 3 d. Germination percentages were determined for all treatments, and seedling vigour was determined for aeration treatments. In seeds imbibed in PEG-free media, germination was better when air was supplied during imbibition. However, seeds imbibed in PEG-free media aerated with oxygen exhibited symptoms of toxicity, and seedlings derived from this treatment exhibited the greatest reduction in shoot and root growth. PEG diminished the adverse effects of oxygen on germination. That 50% PEG was less effective in this respect suggested the contribution of an osmoticum effect that was confirmed by the reduced germination rate of seeds imbibed in air-aerated and non-aerated 25% PEG media. Root growth appeared to be the most sensitive response to oxygen and osmotic treatments of seeds. It was concluded that osmoconditioning was of little value as a mean of improving germination of L. sylvestris seeds and performance of seedlings.
Source: Copyright CAB Abstracts (94-94.6) G650736
Lathyrus sylvestris/ Seed germination/ Osmotic pretreatment/ Oxygen/ Aeration/ Germination/ Seed treatment/ Osmotic priming/ water relations Imbibition/ Seed/ Toxicity/ Seedling/ Plant physiology/ Lathyrism symptoms/ Lathyrism/ Lathyrus sylvestris/ Lathyrus toxicity/ Osmotic/ Polyethylene/ Pretreatment/ Roots/ Root growth/ Seedling germination/ Seedling growth/ Seedling vigour/ Shoots/ Symptoms lathyrism/ Toxicity L. sylvestris/ USA/ Virginia/ Water/ Weed.

Tylleskär, T.; Banea, M.; Bikangi, N.; Cooke, R. D.; Poulter, N. H., and Rosling, H. (1992). **Cassava cyanogens and konzo, an upper motorneuron disease found in Africa**. The Lancet **339**:208-11
Source: reprintDE
Cassava toxicity/ Neurodegenerative diseases Konzo/ Lathyrism/ HCN/ Detoxification Cassava/ Processing/ Bitter varieties Cassava/ Sulfur Thiocyanates/ Sweden/ Myelopathy/ Spastic paraparesis/ Africa/ Cyanides/ Detoxification/ Konzo/ Lathyrism chronic Cassava toxicity/ Manihot esculenta/ Cassava/ Motor neurons/ Neurodegenerative/ Neurology/ Neurons/ Spasticity/ Toxicity/ Varieties/ reprint.

Geda, A.; Briggs, C. J., and Venkataram, S. (1993). **Determination of the neurolathyrogen beta-N-oxalyl-L-alpha,beta-diaminopropionic acid using high performance liquid chromatography with fluorometric detection.** Journal of Chromatography **635** (2):338-341
Source: Agricola (92-94.6) IND 93027976
ODAP analysis/ Method/ Lathyrism/ Neurotoxins/ HPLC/ Lathyrus sativus/ Chromatography/ ODAP.

Hugon, J.; Ludolph, A. C.; Spencer, P. S.; Roldan, S. G., and Dumas, J. L. (1993). **Studies of the etiology and pathogenesis of motor neuron diseases .3. Magnetic cortical stimulation in patients with lathyrism.** Acta Neurologica Scandinavica **88** (6):412-416 (author affiliation: Hugon J Univ Limoges Fac Med Inst Neurol Trop 2 Rue Docteur Marcland F-87025 Limoges France)

Neurophysiological assessments of central motor pathways were conducted of 11 Spanish subjects with varying degrees of spastic paraparesis (lathyrism). The disease has been induced more than 40 years ago by subsistance on the neurotixic chick pea Lathyrus sativus. Patient evolution was carried out by magnetic cortical and electric spinal stimulations and recordings of the contralateral muscle responses. Central motor conduction times corresponding to lower limbs were clearly more prolonged in those severely affected patients with marked difficulty walking (Stages 4 and 3). Central conduction times corresponding to upper limbs were delayed in only 1 patient. Taken together with clinical and published neuropathological data, these findings suggest that established lathyrism is essentially a central motor system disorder primarily affecting corticospinal tracts regulating the lower limbs. [References: 26].
Source: Copyright Current Contents
Lathyrism/ Spastic paraplegia/ Motor evoked potentials/ Clinical neurophysiology/ Human-brain/ Responses/ Sclerosis/ Cortex.

Hugon, J.; Ludolph, A. C.; Spencer, P. S.; Roldan, S. G., and Dumas, J. L. (1993). **Studies on the etiology and pathogenesis of motor neuron diseases. III. Magnetic cortical stimulation in patients with lathyrism.** Acta Neurologica Scandinavica **88** (6):412-416 (author affiliation: Hugon J Univ Limoges Fac Med Inst Neurol Trop 2 Rue Docteur Marcland F-87025 Limoges France; Limoges Univ Hosp Dept Neurol Limoges France; Humboldt Univ Berlin Charite Hosp Dept Neurol O-1086 Berlin Germany; Oregon Hlth Sci Univ Ctr Res Occupat & Environm Toxicol Dept Neurol Portland, Or 97201 USA; Hosp Gen Gregorio Maranon Madrid Spain)
Neurophysiological assessments of central motor pathways were conducted of 11 Spanish subjects with varying degrees of spastic paraparesis (lathyrism). The disease has been induced more than 40 years ago by subsistance on the neurotixic chick pea Lathyrus sativus. Patient evolution was carried out by magnetic cortical and electric spinal stimulations and recordings of the contralateral muscle responses. Central motor conduction times corresponding to lower limbs were clearly more prolonged in those severely affected patients with marked difficulty walking (Stages 4 and 3). Central conduction times corresponding to upper limbs were delayed in only 1 patient. Taken together with clinical and published neuropathological data, these findings suggest that established lathyrism is essentially a central motor system disorder primarily affecting corticospinal tracts regulating the lower limbs. [References: 26].
Source: Reprinted with permission Copyright 1993 Munksgaard Publishers, Copenhagen
Lathyrism Spain/ Spain lathyrism/ Spastic Paraplegia/ Motor Evoked Potentials/ Clinical Neurophysiology/ Neurology/ Lathyrus sativus Chickens/ Evolution/ France/ Germany/ Lathyrism/ Lathyrism etiology/ Lathyrism motor neurons/ Motor neurons/ Muscles/ Neurons/ Oregon Paraplegia/ Spain/ Spain L. sativus/ Spasticity/ Spastic paraparesis/ Spinal cord/ USA.

Jahan, K. and Ahmad, K. (1993). **Studies on neurolathyrism.** Environmental Research **60** (2):259-266 (author affiliation: Institute of Nutrition and Food Science, University of Dhaka, Bangladesh)
Neurolathyrism is a neurological condition seen among people who eat the seeds of Lathyrus sativus (LS) as a principal source of food energy for 2 months or more. It is characterised by severe muscular rigidity and paralysis of the lower limbs. beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid is the principal toxin found in the seed. No experimental animal model for neurolathyrism could be produced by feeding either the seeds or the toxin, although the condition has been known for centuries. We discovered that experimental neurolathyrism could be produced in guinea pigs and primates that needed an external supply of ascorbic acid by making them subclinically deficient in ascorbic acid and feeding them the seeds of LS or extracts thereof. Autoclaving the seeds of LS with lime removes the toxin.
Source: Medline 93231097; Reprinted with permission Copyright 1993 Academic Press
Ascorbic acid metabolism/ Ascorbic acid Deficiency complications/ Ascorbic acid Deficiency metabolism/ Disease Models Animal/ Food Contamination/ Guinea Pigs/ Haplorhini/ Lathyrism chemically induced/ Lathyrism complications/ Lathyrism metabolism/ Legumes adverse effects/ Muscular Diseases chemically induced/ Lathyrism/ Neurology/ Lathyrus sativus/ Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Ascorbic acid/ Vitamin C/ Bangladesh/ Contamination/ Deficiency/ Energy/ Environment/ Extraction/ Feeding/ Food/ Lathyrism animal models/ Lathyrism animals/ Lathyrism Bangladesh/ Lathyrism Bioassay/ Lathyrism nutrition/ Lathyrism vitamin C/ Lime/ Primates Metabolism/ Models/ Muscles/ Neurolathyrism/ Nutrition animal/ Nutrition/ Paralysis/ Rodents/ Seed/ Toxin/ Vitamins.

Khan, J. K.; Kuo, Y.-H.; Haque, R.; Lambein, F., and Haque, A. (1993). **Review on the role of excitatory amino acids in neurological disorders with emphasis on neurolathyrism: a hypothesis for the susceptibility for neurolathyrism**. Bangladesh Journal of Neuroscience **9** (1):24-33.
Activation of glutamate receptors by excitatory amino acids is believed to play a role in the pathogenesis of neurologic diseases. The concentration of amino acids in cerebrospinal fluid differs between neurolathyrism patients and controls. The concentration of the inhibitory neurotransmitter, glycine, shows a clear correlation with the duration of the disease, which resembles sporadic upper motor neurone diseases. Glutamate, zinc and glycine affect activity at the N-methyl-D-aspartate (NMDA) class of glutamate receptor. Zinc in mossy fibre axon is dynamically linked to neural signalling processes. It is proposed that _-ODAP, being a strong

zinc-chelator, can make metal ion complexes within CNS that may lead to the expression of toxicity. A role for zinc deficiency in the susceptibility for neurolathyrism is postulated.
Source: reprintDE
Lathyrus sativus toxicity/ NPAA/ ODAP/ Lathyrism zinc/ Zinc lathyrism/ Zinc/ Metals/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids reviews/ Aspartic acid/ Axons/ Bangladesh/ Central Nervous system/ Cerebrospinal fluid/ Deficiency/ Excitatory amino acid/ Fibre Glutamates/ Glutamates receptors/ Glycine/ Heavy metals/ Lathyrism/ Lathyrism Bangladesh/ Lathyrism cerebrospinal fluid/ Lathyrism review Lathyrus sativus zinc/ Lathyrus toxicity/ Motor neurons/ Nervous system/ Neural/ Neurolathyrism/ Neurons/ NMDA/ NPAA review/ ODAP Zinc/ Receptors/ Review/ Susceptibility/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Trace elements/ Zinc deficiency/ reprint.

Kothari, S. L. (Ed) (1993). **Eat Kesari Dal (Lathyrus sativus) for better health at low cost**. Nagpur, M. S.: Academy of Nutrition Improvement.
Advocates that Lathyrus sativus is safe to eat and ignores malnutrition and poverty as being causally linked to lathyrism.
Source: reprintDE
Pamphleteering L. sativus/ India L. sativus consumption/ Lathyrus sativus India/ Human consumption L. sativus India/ Famine/ Malnutrition Poverty/ Economics/ Lathyrus sativus/ Dhal/ Human consumption/ India/ India L. sativus/ India malnutrition/ India lathyrism/ Khesari Lathyrism/ Lathyrism economics/ Lathyrism India/ Lathyrism nutrition/ Humans/ Nutrition/ reprint.

Kumari, V.; Mehera, R. B.; Baju, D. B., and Hima Bindu, K. (1993). **Genetic basis of flower colour production in grass pea**. Lathyrus and Lathyrism Newsletter **5**:10
Source: reprintDE
Flower colour genetics L. sativus/ Lathyrus sativus flower colour genetics/ Genetics flower colour L. sativus/ Breeding/ Genetics/ Lathyrus sativus/ Colour/ Flower colour/ Flower colour genetics/ Flowers/ Genetics flower colour/ reprint.

Miller, S.; Nunn, P. B., and Bridges, R. J. (1993). **Induction of astrocyte glutamine synthetase activity by the Lathyrus toxin beta N oxalyl L alpha,beta diaminopropionic acid (beta L ODAP).** Glia **7** (4):329-336 (author affiliation: Department of Psychobiology, University of California, Irvine 92717)
beta-N-Oxalyl-L-alpha,beta-diaminopropionic acid (beta-L-ODAP) is thought to be the causative agent in lathyrism due to its neuroexcitatory and neurotoxic properties. We have recently reported that beta-L-ODAP is also gliotoxic at high concentrations (Bridges et al.: Brain Res 561:262, 1991). Evidence is now presented that low, subgliotoxic concentrations of beta-L-ODAP may alter the ability of astrocytes to regulate glutamate concentrations in the CNS by increasing astrocyte glutamine synthetase activity. When astrocytes cultured from rat cortex were exposed to 100 microM beta-L-ODAP for 24 h, the resulting glutamine synthetase activity was 155% of control levels. This effect was enantiomer- and isomer-specific, dose-dependent, and required protein translation as the induction was blocked with cycloheximide. The effect of beta-L-ODAP on glutamine synthetase was not mimicked by alpha-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA) or kainate, suggesting that the induction was not transduced solely through activation of cell surface non-N-methyl-D-aspartate (NMDA) glutamate receptors. An intracellular site of action of beta-L-ODAP is proposed because its effect on glutamine synthetase activity could be blocked by the amino acid uptake blocker dihydrokainate.
Source: Medline 93307820
Animals Newborn/ Astrocytes cytology/ Astrocytes drug effects/ Cell Death drug effects/ Cells Cultured/ Cerebral Cortex cytology/ Cerebral Cortex enzymology/ Cycloheximide pharmacology/ Dactinomycin pharmacology/ Dose Response Relationship Drug/ Enzyme Induction Glutamine Synthetase metabolism/ Ibotenic Acid analogs and derivatives/ Ibotenic Acid pharmacology/ Kainic Acid pharmacology/ Lactate Dehydrogenase analysis/ N Methylaspartate pharmacology/ Rats/ Rats Sprague Dawley/ Structure Activity Relationship/ Amino acids Diamino pharmacology/ Astrocytes enzymology/ Glutamine Synthetase biosynthesis/ Neurotoxins pharmacology/ Rodents/ ODAP/ Neurology/ Amino acids/ AMPA receptors/ Aspartic acid/ Astrocytes/ Biosynthesis/ Brain/ California/ Central Nervous system/ Cerebral Cortex/ Cycloheximide Cytology/ Drugs/ Enzymes/ Glutamates/ Glutamine/ Glutamates receptors/ Ibotenic acid/ Intracellular/ Isomerism ODAP/ Isomerism/ Kainic acid/ Lactate/ Lathyrism/ Lathyrism animals/ Lathyrism enzymology/ Lathyrism rats/ Metabolism plant/ Nervous system/ Neuroexcitatory Neurotoxins/ NMDA/ ODAP biosynthesis/ ODAP isomerism/ Protein/ Receptors/ Toxin/ Toxin biosynthesis.

Misra, U. K.; Sharma, V. P., and Singh, V. P. (1993). **Clinical aspects of neurolathyrism in Unnao, India.** Paraplegia **31** (4):249-254 (author affiliation: Department of Neurology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India)
To study the clinical picture of lathyrism in Unnao, India and compare it with that reported from other endemic areas, 41 patients from Unnao were studied. Their mean age was 42.9 years (range 22-85) and the mean duration of the illness was 17.1 years (range 2-30). They had been regularly consuming Lathyrus sativus (LS). The patients complained of walking difficulty due to weakness and leg stiffness (32 each), and of frequency of micturition (4). Gait abnormalities included spastic gait (24), toe walking (18) and the necessary use of walking sticks (13). Weakness was mild to moderate, and was less prominent than was spasticity. In 8 patients the physical signs were asymmetrical. Peripheral neuropathy was present in only one patient, but muscle atrophy and widespread fasciculations were not found. A higher frequency of peripheral neuropathy and lower motor neuron involvement has been reported from Bangladesh and Israel. Severe spasticity in the

absence of prominent weakness in lathyrism may be due to the involvement of certain specific groups of corticospinal fibres.
Source: Medline 93261714; Reprinted with permission. Copyright (1993) Stockton Press
Adult/ Aged/ Aged 80 and over/ Diet/ Gait/ India/ Lathyrism therapy/ Middle Age/ Muscle Spasticity physiopathology/ Lathyrism physiopathology/ Neurology/ Lathyrus sativus/ Palestine/ Age/ Bangladesh/ Endemic/ Fibre/ India Dietary/ Dietary/ India L. sativus/ India lathyrism/ Lathyrism/ Lathyrism Aged/ Lathyrism Bangladesh/ Lathyrism India/ Lathyrism motor neurons/ Motor neurons/ Muscles/ Muscle spasticity/ Neurolathyrism/ Neurons/ Paraplegia/ Peripheral/ Physical/ Spasticity.

Pai, K. S. and Ravindranath, V. (1993). **L-BOAA induces selective inhibition of brain mitochondrial enzyme NADH-dehydrogenase.** Brain Research **621** (2):215-221 (author affiliation: Ravindranath V Natl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka IndiaNatl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka India)
Lathyrism, a human neurological disorder has been linked to the excessive consumption of a plant toxin, beta-oxalylamino-L-alanine L-B present in Lathyrus sativus. The present study was carried out to elucidate the biochemical mechanisms underlying L-BOAA-induced toxic insult. Incubation of sagittal slices of mouse brain with L-BOAA resulted in dose and time-dependent inhibition of mitochondrial NADH-dehydrogenase (NADH-DH). Significant inhibition of NADH-DH was seen following incubation of brain slices with very low concentration of L-BOAA (0.1 pM). L-BOAA also induced lactate dehydrogenase (LDH) leakage from the slice into the medium in dose-dependent manner. The inhibition of NADH-DH preceded LDH leakage from the slices into the medium. L-BOAA had no effect on other mitochondrial enzymes, namely, isocitrate dehydrogenase or cytochrome c oxidase. Incubation of isolated mouse brain mitochondria with L-BOAA also resulted in inhibition of NADH-DH. L-BOAA-induced inhibition of NADH-DH was prevented by non-N-methyl-D-aspartate (non-NMDA) glutamate receptor antagonists in general and alpha-amino-3-hydroxy-5-methylisoxazole-4-propionate (AMPA) receptor antagonist (NBQX) in particular. Other glutamate agonists examined namely, N-methyl-D-aspartate, beta-N-methylamino-L-alanine (L-BMAA), L-glutamic acid, N-acetylaspartylglutamate (NAAG), quisqualic acid, kainic acid or AMPA did not have any effect on NADH-DH activity in slices although they induced LDH leakage from the slice into the medium. Incubation of brain slices with L-BOAA did not induce lipid peroxidation or changes in glutathione levels. Prior incubation of slices with glutathione (GSH) or GSH-isopropyl ester did not prevent L-BOAA-induced inhibition of NADH-DH. However, incubation of isolated mitochondria with L-BOAA in the presence of GSH-isopropyl ester prevented L-BOAA-induced inhibition of NADH-DH, indicating the protective effect of mitochondrial glutathione in the prevention of L-BOAA-induced toxicity. [References: 41].
Source: ref ex Roy (pers. comm.); Reprinted with permission Copyright 1993 Elsevier Science B.V., Amsterdam, Netherlands
Quinoxalinediones/ Glutamates Receptor/ ODAP toxicity/ ODAP brain NADH-dehydrogenase/ NADH-dehydrogenase ODAP/ Lathyrus sativus toxicity/ Toxicity mechanism ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Amino acids/ AMPA receptors/ Aspartic acid/ Brain/ Enzymes/ Excitatory amino acid/ Glutamates/ Glutamates receptors/ Glutathione/ India/ India L. sativus/ India L. sativus consumption/ India lathyrism/ Isocitrate dehydrogenase/ Kainic acid/ Lactate dehydrogenase/ Lactate/ Lathyrism/ Lathyrism India/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism prevention/ Lathyrus toxicity/ Lipids/ Humans/ Mechanisms toxicity/ Mental/ Mice/ Mitochondria/ NADH/ NBQX/ NMDA/ ODAP/ Prevention lathyrism Lathyrism prevention/ Receptors/ Rodents/ Sulfur amino acids/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity Toxin.

Pai, K. S.; Shankar, S. K., and Ravindranath, V. (1993). **Billionfold difference in the toxic properties of the two excitatory amino acids, L-BOAA and L-BMAA: biochemical and morphological studies using mouse brain slices.** Neuroscience Research **17** (3):241-248 (author affiliation: Ravindranath V Natl Inst Mental Hlth & Neurosci Dept Neurochem Hosur Rd Bangalore 560029 Karnataka India)
Plant amino acids beta-N-oxalylamino-L-alanine (L-BOAA, present in Lathyrus sativus) and beta-N-methylamino-L-alanine (L-BMAA, present in Cycas circinalis) have been implicated in the pathogenesis of human neurological disorders lathyrism and amyotrophic lateral sclerosis-Parkinson's dementia complex of Guam (ALS-PD), respectively. In view of the conflicting reports that have emerged on the role of L-BMAA in ALS-PD, we reinvestigated the comparative toxicity of L-BMAA and L-BOAA. We report here the potent toxicity of L-BOAA as examined in an in vitro model consisting of sagittal slices of mouse brain. Incubation of sagittal slices of mouse brain with L-BOAA (1 pM) resulted in significant leakage of lactate dehydrogenase (LDH) and potassium from the slices into the medium. Under similar conditions, L-BMAA-induced LDH leakage from the slices into the medium was observed only at very high concentration of the toxin, namely 1 mM. N-Methyl-D-aspartate (NMDA) receptor antagonists ameliorated the toxic effects of L-BMAA, while non-NMDA receptor antagonists (quinoxalinediones) protected against the toxicity of L-BOAA. Incubation of slices with L-BOAA for 1 h resulted in extensive vacuolation and degeneration of neurons in the thalamus and brain stem, and to a lesser extent in the hippocampus and cerebellar nuclei. The large sized neurons appeared to be affected to a greater extent than the smaller ones. The neurons in other

areas of the brain also revealed variable degree of degeneration with swelling of axons and dendrites. Thus, the present study demonstrates the potent toxicity of L-BOAA and elucidates for the first time, the billion-fold difference in the concentration of L-BOAA and L-BMAA required to elicit similar toxic response in vitro, using mouse brain slices. The study also demonstrates the selective vulnerability of certain regions of the brain to toxic insult by L-BOAA. [References: 19].
Source: ref ex Roy (pers. comm.)
Neurotoxicity/ Excitatory Amino Acid/ Quinoxalinediones/ NMDA receptor/ Glutamates Receptor/ ODAP toxicity/ Beta N-methylamino-L-alanine toxicity/ Toxicity ODAP/ NPAA toxicity/ Brain slice bioassay/ Bioassay brain slice/ Rodents bioassay/ Bioassay rodent/ Neurology/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives/ Beta N-methylamino-L-alanine/ Bioassay L. sativus Lathyrus sativus bioassay/ Axons/ Amino acids/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Cycas/ Dendrites/ Glutamates/ Glutamates receptors/ Guam/ Hippocampus/ In vitro/ India/ India L. sativus/ India lathyrism/ Lactate dehydrogenase/ Lactate/ Lathyrism/ Lathyrism Bioassay/ Lathyrism hippocampus/ Lathyrism India/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Humans/ Mental/ Mice/ Models/ Neurons NMDA/ NPAA/ Nuclei/ ODAP/ Potassium/ Receptors/ Reports/ Rodents/ Toxicity L. sativus/ Toxicity rodents bioassay/ Toxicity/ Toxin.

Rasmussen, M. A.; Allison, M. J., and Foster, J. G. (1993). **Flatpea intoxication in sheep and indications of ruminal adaptation.** Veterinary and Human Toxicology **35** (2):123-127
In a series of experiments lambs were adapted to feeding with pellets containing seed-bearing flatpea (Lathyrus sylvestris L.) by increasing flatpea content from 50% to 100% in steps of 10% for periods of 7 days at each level. The rumen contents of some adapted lambs were exchanged with the rumen contents of lambs fed alfalfa. All exchanged lambs were fed flatpea in hay at 2200 g/day. In a third experiment lambs adapted to flatpea at 60% for 7 days were fed 100% flatpea for 62 days. These lambs were then fed monensin (30 mg/kg daily). Signs of intoxication included seizure, muscular trembling and spasmotic torticollis, and were similar to those seen in ammonia toxicosis in ruminants. Accumulation of ammonia may be a direct consequence of flatpea ingestion since 2,4-diaminobutyric acid (DABA), a toxic constituent, is known to inhibit hepatic urea synthesis. Other modes of toxicity for DABA and other flatpea toxins may contribute to this process of intoxication. The results suggest that ruminal microbes are responsible for flatpea detoxification and protection. The adaptation of sheep to flatpea may be due to increased ruminal detoxification. Ruminal protective functions can be disrupted through abrupt monensin feeding or the replacement of non-adapted for adapted rumen contents. This disruption temporarily suppresses mechanisms of ruminal detoxification and the sheep can reacquire vulnerability to flatpea intoxification.
Source: Agricola (92-94.6) IND 20380600, Reprinted with permission Copyright (1993) American College of Veterinary Toxicologists
Animal experiments/ Poisoning/ Rumen microorganisms/ Monensin/ Lathyrus/ Sheep/ Poisonous plants/ Lathyrus sylvestris/ Toxicity Detoxification/ Ruminants/ Antinutritional factors/ Adaptation/ DABA/ Hay/ Agriculture/ Lathyrism symptoms/ Medicago sativa/ Ammonia Feeding/ Feed ruminants/ Feed Lathyrus ochrus/ Feed Lathyrus sylvestris/ Lambs/ Lathyrism/ Lathyrism animals/ Lathyrism mechanisms Lathyrism veterinary/ Lathyrus ochrus/ Lathyrus sylvestris/ Lathyrus toxicity/ Liver/ Humans/ Mechanisms toxicity/ Medicago/ Microorganisms Muscles/ Rumen/ Ruminant feed/ Seed/ Sheep feed/ Symptoms lathyrism/ Toxicity L. sylvestris/ Toxin/ Urea.

Rowe, L. D.; Ivie, G. W.; DeLoach, J. R., and Foster, J. G. (1993). **The toxic effects of mature flatpea (Lathyrus sylvestris L cv Lathco) on sheep.** Veterinary and Human Toxicology **35** (2):127-133 (author affiliation: Food Animal Protection Research Laboratory, USDA-ARS, Route 5, Box 810, College Station, TX 77845, USA)
Groups of 5 adult ewes, assigned by weight and reproductive status (barren or in last 10 weeks of pregnancy), were fed pelleted diets containing mature, seed-bearing flatpea at 0, 35.0, 52.5 or 70.0% for 42 days, or at increasing levels of 17.5, 35.0, 52.5 and 70.0% over 42 days. The dose-related responses to the diets included a fluctuating reduction in feed intake for diets containing 35% and above of flatpea, potentially fatal acute central nervous signs at levels as low as 35%, and reduced weight gains at levels of 52.5% and over. A wasting condition developed in one ewe fed at 52.5%. Four of 5 ewes and one lamb fed increasing levels developed acute signs of poisoning. One of these ewes developed acute neurotoxicosis when fed at the 52.5% level; 3 other ewes and one orphaned lamb (40 days old) developed neurotoxicosis at the 70.0% level. 18 lambs were born to 16 flatpea-fed ewes in this study; there was no evidence that flatpea feeding adversely affected late pregnancy, parturition, lactation or lamb health.
Source: Reprinted with permission Copyright (1993) American College of Veterinary Toxicologists
Animal experiments/ Wasting diseases/ Lathyrus spp sheep poisoning/ Poisonous plants sheep/ Lathyrus sylvestris toxicity/ Ewes/ Reproduction Intake/ Ruminants/ Agriculture/ Lathyrism symptoms/ Diet/ Dietary intake/ Feed/ Feeding/ Feed ruminants/ Feed intake/ Feed Lathyrus ochrus Feed Lathyrus sylvestris/ Food/ Dietary/ Lambs/ Lathyrism/ Lathyrism animals/ Lathyrism veterinary/ Lathyrus ochrus/ Lathyrus sylvestris Lathyrus spp/ Lathyrus toxicity/ Humans/ Poisonous plants/ Pregnancy/ Ruminant feed/ Seed/ Sheep/ Sheep feed/ Symptoms lathyrism/ Toxicity L. sylvestris/ Toxicity Lathyrus spp/ Toxicity/ USA/ USDA.

Spencer, P. S.; Ludolph, A. C., and Kisby, G. E. (1993). **Neurologic diseases associated with use of plant components with toxic potential.** Environmental Research **62** (1):106 (author affiliation: Center for Research on Occupational and Environmental Toxicology, Oregon Health Sciences University, Portland 97201)

Epidemics of neurotoxic disease in developing regions of the world are often associated with dietary dependence on plant components with inherent toxic potential or which have spoiled and become contaminated with mycotoxins. Diseases triggered by plant toxins include lathyrism and cassavism, types of irreversible spastic parapareses associated with staple diets of grass pea and bitter cassava root, respectively. Mildewed sugarcane poisoning, an encephalopathy and tardive dystonia, illustrates the neurotoxic effects of a widely distributed plant and fungal toxin. Food and medicinal use of the neurotoxic cycad plant is thought to have a role in the etiology of western Pacific amyotrophic lateral sclerosis and parkinsonism-dementia. Plant-associated neurotoxicity is a significant and preventable cause of morbidity in certain regions of Africa, Asia, and Oceania.
Source: Medline 93314607; Reprinted with permission Copyright 1993 Academic Press
Plants Toxic chemistry/ Nervous system diseases chemically induced/ Plants Toxic/ Neurology/ Antinutritional factors/ Mycotoxins/ Africa Amyotrophic lateral sclerosis/ Asia/ Chemistry/ Diet/ Environment/ Food/ Fungi/ Mycology/ Dietary/ Lathyrism etiology/ Lathyrism mycotoxins/ Manihot esculenta/ Cassava/ Medicinal/ Microbiology/ Nervous system/ Neurotoxicity/ Neurotoxins/ Oregon/ Phytochemistry Prevention lathyrism/ Lathyrism prevention/ Roots/ Spasticity/ Toxin/ Nervous system diseases.

Tekle Haimanot, R.; Abegaz, B. M.; Wuhib, E.; Kassina, A.; Kidane, Y.; Kebede, N.; Alemu, T., and Spencer, P. S. (1993). **Pattern of Lathyrus sativus (grass pea) consumption and beta-N-oxalyl-alpha,beta-diaminopropionic acid (beta-ODAP) content of food samples in the lathyrism endemic region of Northwest Ethiopia.** Nutrition Research **13** (10):1113-1126 (author affiliation: Faculty of Medicine, Addis Ababa University, P.O.Box 4147, Addis Ababa)
Grass pea, a legume whose consumption is associated with human lathyrism, is an important food crop among the poorer sectors of society in many parts of Ethiopia. A nutritional survey, focussing on the preparation and consumption of grass pea, in 224 families of two villages of a lathyrism endemic area in northwestern Ethiopia has been undertaken. Grass pea is grown in only one of the two villages. Raw as well as cooked food samples were collected and the levels of beta-ODAP determined by the OPT-method. Grass pea foods were also prepared in the laboratory following methods used in the villages and analysed for their toxin level to derive information if certain procedures were capable of reducing the level of toxin. Steeping grass pea in excess water leaches out ca 30% of the beta-ODAP. Grass pea bread (kitta) and roasted seeds (kollo) showed elevated levels of beta-ODAP as compared to the seeds used in the preparation of these foods. Lower levels of beta-ODAP were found in boiled snacks (nifro) and the flour form (shiro).
Source: Lambein_95_5
Lathyrism Ethiopia/ Ethiopia lathyrism/ Ethiopia nutritional survey/ Lathyrus sativus food preparation/ ODAP L. sativus food/ Human consumption L. sativus/ Lathyrus sativus/ Agriculture/ Bread/ Endemic/ Ethiopia/ Flour/ Food L. sativus/ Food preparation/ Food/ Human consumption/ Lathyrism/ Lathyrism nutrition/ Humans/ Nutrition/ Nutrition surveys/ ODAP/ Seed/ Surveys/ Toxin/ Water.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kassina, A.; Endeshaw, Y.; Alemu, T., and Spencer, P. S. (1993). **The epidemiology of lathyrism in north and central Ethiopia.** Ethiopian Medical Journal **31** (1):15-24 (author affiliation: Faculty of Medicine, Addis Ababa University, Ethiopia)
Lathyrism is a neurotoxic disorder caused by excessive, prolonged consumption of the hardy, environmentally tolerant legume, the grass-pea, Lathyrus sativus, which contains the neurotoxic amino acid beta-N-oxalylamino-L-alanine acid (BOAA). The disease develops after heavy consumption of grass-pea for over two months. It is uniformly manifested by a predominantly motor spastic paraparesis with varying degrees of disability. A door-to-door epidemiological survey for the disease using trained lay health workers was carried out in the major areas of northwest and central Ethiopia where L. sativus is grown. For security reasons, some of the other endemic areas were not accessible for the survey. The survey involved a population of 1,011,272. A total of 3,026 affected persons were identified. The disease was found to be widespread in the northwest and central highland areas of the country. The prevalence rates ranged from 1/10,000 to 7.5/1,000. The highest prevalences were in North and South Gonder, and East and West Gojam. The male:female ratio of cases was 2.6:1; the females exhibited a milder form of the disease. The cultivation of L. sativus is increasing in Ethiopia, which makes the development of low-BOAA strains very important in order to control the high incidence of lathyrism, a crippling disease which affects the productive young members of the society.
Source: Medline 93170259 ; reprintDE, reprinted with permission Copyright 1993 Ethiopian Medical Journal
Adolescence/ Adult/ Child/ Child Preschool/ Diet Surveys/ Ethiopia epidemiology/ Incidence/ Lathyrism etiology/ Lathyrism prevention and control/ Population Surveillance/ Prevalence/ Rural Population/ Lathyrism epidemiology/ ODAP/ Neurology/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Cultivation/ Diet/ Endemic/ Epidemiology lathyrism/ Ethiopia/ Female/ Lathyrism/ Lathyrism Adolescence/ Lathyrism Ethiopia/ Lathyrism prevention/ Males/ Humans/ Neurotoxins/ Population/ Prevention lathyrism/ Lathyrism prevention Rural/ Spasticity/ Spastic paraparesis/ Strains/ Surveys/ Tolerance/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1993). **Neuronal damage induced by beta-N-oxalylamino-L-alanine, in the rat hippocampus, can be prevented by a non-NMDA antagonist, 2,3-dihydroxy-6-nitro-7-sulfamoyl-benzo(f)quinoxaline.** Brain Research **627** (1):55-62 (author

affiliation: Willis Cl Inst Psychiat Dept Neurol Denmark Hill London Se5 8af England; Inst Psychiat Dept Neurosci London Se5 8af England; Univ London Kings Coll Div Biomed Sci London Wc2r 2ls England)
The neurotoxin beta-N-oxalylamino-L-alanine (BOAA), found in Lathyrus sativus seeds, is thought to be the causative agent of neurolathyrism. We have investigated the in vivo mechanism of action of BOAA by focal injection (1 mul) in the dorsal hippocampus of male Wistar rats and comparing the pathological outcome with the effects of injections (1 mul) of a-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA), kainate (KA) or N-methyl-D-aspartate (NMDA). Cellular damage induced by the excitatory amino acids in the pyramidal (CA1-CA4) and dentate granule neurones (DG) was assessed histologically 24 h after the injection. The study shows that BOAA (50 nmol) induces hippocampal toxicity with a highly selective pattern of regional cellular damage. The CA1, CA4 and DG subfields show 70-90% neuronal injury whereas CA2 and CA3 show only minimal damage. This pattern of cellular damage is similar to that induced by AMPA (1 nmol) and NMDA (25 nmol) but not KA (0.5 nmol). BOAA-induced neurotoxicity is prevented in a dose-dependent manner by focal co-injection of the non-NMDA receptor antagonist 2,3-dihydroxy-6-nitro-7-sulfamoyl-benzo(F)quinoxaline (NBQX) (1-25 nmol) but not by a dose of MK-801 (3 mg/kg i.p.) which is neuroprotective against an injection of NMDA. Delayed focal injections of NBQX (25 nmol) up to 2 h after the BOAA injection result in a significant protection of all pyramidal and granular cell regions. These results indicate that the in vivo hippocampal toxicity of BOAA is mediated by AMPA receptors rather than by KA or NMDA receptors. Neurones in the rat hippocampus do not die immediately when exposed to BOAA but via a delayed process involving sustained AMPA receptor activation. Excitotoxic processes acting via AMPA receptors may play a role in the chronic loss of motor neurones seen in amyotrophic lateral sclerosis. [References: 39].
Source: Reprinted with permission Copyright 1993 Elsevier Science B.V., Amsterdam, Netherlands
ODAP/ NBQX/ Neurotoxicity/ Neurolathyrism/ Motor neuron disorder/ Excitatory amino acid/ ODAP toxicity prevention/ Lathyrism/ Bioassay rodent/ Rats/ KA receptors/ NMDA receptors/ Neurology/ Biochemistry/ Lathyrus sativus/ Bioassay/ Beta Alanine analogs and derivatives Bioassay L. sativus/ Lathyrus sativus bioassay/ Amino acids/ Amino acids toxicity/ AMPA receptors/ Amyotrophic lateral sclerosis/ Aspartic acid/ Brain/ Denmark/ England/ Hippocampus/ Injections/ Kainic acid/ Lathyrism Bioassay/ Lathyrism Biochemistry/ Lathyrism hippocampus Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism prevention/ Lathyrism rats/ Lathyrus toxicity/ Males/ Mechanisms toxicity/ Motor neurons/ Neurons/ Neurotoxins/ NMDA/ Prevention lathyrism/ Lathyrism prevention/ Receptors/ Rodents/ Seed/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity mechanism ODAP/ Toxicity rodents bioassay/ Toxicity/ UK.

Abegaz, B. M.; Nunn, P. B.; De Bruyn, A., and Lambein, F. (1994). **Thermal isomerization of N-oxalyl derivatives of diamino acids**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 89-96.
Source: reprintDE
NPAA/ NPAA chemistry/ ODAP chemistry/ Chemistry/ Ethiopia/ Lathyrism Ethiopia/ ODAP/ ODAP isomerism/ Isomerism ODAP Temperature/ reprint.

Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (1994). (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation.
Source: reprintDE
Lathyrism/ Lathyrus sativus/ Ethiopia/ Lathyrism Ethiopia/ reprint.

Addis, G. and Narayan, R. K. J. (1994). **Quantitative variation in the amount of neurotoxin, beta-N-oxalyl-alpha,beta-diamino-propionic acid, in Lathyrus sativus during ontogeny**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 83-88.
Species of Lathyrus accumulate a variety of secondary metabolites in their seeds, many of which are potentially toxic to man and animals. beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP) assumes the greatest significance. It is a non-protein amino acid which causes both human and animal lathyrism. A study was conducted to assess variations in the amount of ODAP between Lathyrus species, between varieties of Lathyrus sativus and between tissues and organs in L. sativus during different developmental stages. High-voltage electrophoresis, thin-layer chromatography and chemical analysis were used during the investigation. Significant variations in the amount of ODAP between Lathyrus species and between varieties of L. sativus were observed. Results further established that during ontogeny, the biosynthesis and accumulation of ODAP was tissue specific and developmentally regulated. The reproductive organ tissues accumulated more ODAP than vegetative parts during development.
Source: reprintDE

Lathyrus sativus development/ ODAP biosynthesis/ Development L sativus ODAP/ Biosynthesis/ Lathyrus sativus/ Amino acids/ Chemical analysis/ Chromatography/ Electrophoresis/ Ethiopia/ Lathyrism animals/ Lathyrism Ethiopia/ Lathyrus toxicity/ Humans/ Neurotoxins/ ODAP Ontogeny/ Protein/ Reproduction/ Seed/ Tissue/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Varieties/ reprint.

Araya, W. A. (1994). **Adaptation of low neurotoxin lines of grass pea (L sativus) introduced from Canada and tested at Adet, Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 79-82.
Low neurotoxic lines of grass pea supplied by Dr. Campbell, Manitoba Research Station, Canada, were tested out at Adet Research Center, Ethiopia in 1991/92. The tests were carried out in a Cambisol soil type. The materials were planted on Oct. 3, 1991 in a single-rowed non-replicated nursery. Objectives were (i) to test, under Adet conditions, the adaptability of introduced low neurotoxin lines from Canada, and (ii) to identify genes or characters from low neurotoxin lines that could be incorporated into local genotypes. Data collected included days to flowering, days to maturity, powdery mildew (0-9 scale), height (cm), pods/plant, flower color, and growth habit. The yield was not measured because of conditions during the test period were beyond control; however, yield components were determined. The results showed that the local check had the highest number of pods/plant comparatively. NC8a-95 and NC8a-97/1 had the highest pods/plant of the low neurotoxin lines; NC8a-97/1 also had the highest number of seeds/pod (3 seeds/pod). None of the low neurotoxin lines were free of powdery mildew attack. Promising lines, which included NC8a-97/1, NC8a-157, NC8a-84, LS 8246, and NC8a-95, should be tested further in variety and verification trials to determine their performance or to incorporate the low neurotoxin character from the germplasm into promising local genotypes.
Source: reprintDE
Lathyrus sativus adaptation/ Adaptation L sativus Ethiopia/ Lathyrus sativus low ODAP/ Powdery mildew/ Phytopathology/ Adaptation/ Soil Lathyrus sativus/ Agriculture/ Genetic resources/ Canada/ Colour/ Erysiphe/ Ethiopia/ Evaluation genetic resources/ Flowering/ Flowers/ Fungi Mycology/ Genes/ Genotypes/ Habit/ Height/ Lathyrism Ethiopia/ Manitoba/ Maturity/ Microbiology/ Neurotoxins/ Pods/ Seed/ Soil microbiology/ Soil type/ Yield/ Yield components L. sativus/ Yield L. sativus/ Diseases plant/ reprint.

Araya, W. A. (1994). **An effort to improve grass pea (L sativus) in some parts of Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 73-78.
One of the solutions for the problem of lathyrism is the identification and utilisation of low-ODAP lines of grass pea. A a total of 20 grass pea varieties was tested at Adet Research Center, Ethiopia for a period of two years in 1989/90 and 1990/91. The test was done in a randomised complete block design with four replications. The data collected included number of days to flowering, maturity, height (cm), pods/plant, seeds pod, 1000 grain weight, grain yield, and ODAP content. There was no significant yield difference among the varieties in 1990/1991. When averaged over the two years, PGRCE 46066 was the highest yielding variety with a yield level of 3426 kg ha-1. The ODAP level of the varieties varied in different seasons; however, there were varieties where the variation was negligible. When averaged over the two years, PGRCE 201538 had a minimum ODAP level of 0.35%. PGRRCE 201513, one of the best yielding varieties of those tested, had the lowest ODAP levels. More elaborate studies on the relationship between ODAP content and environment interaction are required.
Source: reprintDE
Lathyrus sativus Ethiopia/ Ethiopia L sativus improvement/ ODAP/ Lathyrus sativus/ Environment/ Ethiopia/ Flowering/ Height/ Lathyrism Ethiopia/ Maturity/ Pods/ Seed/ Seed yield/ Utilisation/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Yield/ Yield L. sativus/ reprint.

Cohn, D. F. (1994). **Does neurolathyrism affect longevity?** In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 33-35.
Source: reprintDE
Lathyrism longevity/ Neurology/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ Longevity/ Neurolathyrism/ reprint.

Dibabe, A.; Araya, W. A.; Hundie, B.; Ensermu, R.; Haile, W.; Ashagrie, Y.; Yalew, A., and Seyoum, W. (1994). **The status of grass pea (Lathyrus sativus) research and production in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 45-60.
Grass pea (Lathyrus sativus) occupies 8.7 % of the total area and 7.6 % of the total production of food legumes in Ethiopia. It is produced in areas with adverse agricultural conditions. It performs well on heavy

black soils which promote waterlogging. Grass pea production is mainly concentrated in the northwest zone (58.0%), the central zone (16.3%), the north-east (12.8%), and the northern as well as the southeast region of Ethiopia (12.9). Like most crops in Ethiopia, grass pea grain is used for human consumption and the straw as animal feed. One of the ways to utilise the crop properly is through the identification of grass pea varieties with low ODAP toxin and reasonable yield. A total of 177 grass pea germplasm accessions has been identified and varieties with a ODAP content of 0.2-0.5 % advanced to the next stages. The seed yield data of the variety trials conducted in 1989 and 1991 revealed that the overall mean yields were 2856 kg/ha and 3297 kg/ ha, respectively. PGRC/E46060 gave the highest yield of 3385 kg/ha in 1989, whereas PGRC/E46066 gave the highest yield of 3661 kg/ha in 1991. There was no correlation between ODAP content and yield components. The major diseases that attack grass pea are rust and powdery mildew. The major insects are aphids, thrips and bollworm. Aphids are the most important pest. Most of the farmer's fields assessed were low in weed infestation. Weeds such as Hygrophylla auriculata, Guizotia scabra, Cynodon dactylon, Lactuca serriola, Pennisetum romosum and Daucus carota were found to be the major weeds of grass pea in the northwestern region of Ethiopia. A survey on the nodulation pattern of grass pea was done in the major grass pea-growing areas of the northwest. Most of the nodules in the samples collected were not effective in fixing nitrogen from the atmosphere.

Source: reprintDE

Lathyrus sativus research Ethiopia/ Ethiopia L. sativus research/ ODAP/ Agronomy/ Farming systems/ Waterlogging/ Phytopathology/ Soil Lathyrus sativus/ Entomology/ Straw/ Agriculture/ Genetic resources/ Animal feed/ Aphids/ Erysiphe/ Ethiopia/ Feed/ Feed Lathyrus sativus Flooding/ Food/ Fungi/ Mycology/ Guizotia/ Human consumption/ Insects/ Lathyrism/ Lathyrism animals/ Lathyrism Ethiopia/ Lathyrus sativus agronomy/ Humans/ Microbiology/ Nitrogen/ Nodulation/ Pests/ Powdery mildew/ Rust/ Seed/ Seed yield/ Soil microbiology/ Surveys/ Toxin Varieties/ Variety trials/ Varieties L. odoratus/ Varieties L. sativus/ Lathyrus sativus varieties/ Lathyrus odoratus varieties/ Water/ Weed/ Yield Yield components L. sativus/ Yield L. sativus/ Diseases plant/ reprint.

Gimenez-Roldan, S.; Ludolph, A. C.; Hugon, J.; Hens, M.; Mateo, D.; Kisby, G. E., and Spencer, P. S. (1994). **Lathyrism in Spain: Progressive central nervous system deficits more than 45 years after onset**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 10-25.

During the famine following the Spanish Civil war (1936-1939), outbreaks of human lathyrism occurred in the Spanish provinces of Catalonia and Castillia because of heavy consumption of food containing Lathyrus spp. seed, a neurotoxic legume. In June 1988, we studied 14 male subjects, aged 49-70 years, who developed lathyrism during childhood or adolescence, for evidence of recent clinical deterioration. Each patient displayed a characteristic pattern of neurological deficit, and 10 complained of deterioration of motor performance (increased leg stiffness, shortening of steps and a tendency to scrape the floor with toes) which had developed over the previous 2-10 years. This was reportedly accompanied by the appearance, or by an increase of severity and frequency, of painful nocturnal calf-muscle cramping. Five of the 10 no longer consumed Lathyrus, while 3 or 4 with seemingly static illness reported continued occasional intake. However, 8 of 9 patients showed measurable levels of the Lathyrus neurotoxin, alpha-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP). Age, disease duration, clinical severity at onset, and continued consumption of Lathyrus spp., could not be associated with susceptibility to deterioration. Finally, the clinical presentation and pattern of neurological deficit in Spanish peasants with lathyrism closely resembles that of Bangladesh, Ethiopian, Indian, and Israeli patients, but was clearly different from the rapidly progressive disease seen in sporadic amyotrophic lateral sclerosis.

Source: reprintDE

Lathyrism Spain/ Spain lathyrism/ Ruminants/ ODAP/ Neurology/ Famine/ Malnutrition/ Cattle/ Agriculture/ Age/ Amyotrophic lateral sclerosis/ Bangladesh/ Calves/ Central Nervous system/ Ethiopia/ Food/ India/ India malnutrition/ India lathyrism/ Intake/ Lathyrism/ Lathyrism Adolescence/ Lathyrism Aged/ Lathyrism Bangladesh/ Lathyrism Ethiopia/ Lathyrism India/ Lathyrus spp/ Males/ Humans/ Muscles/ Nervous system/ Neurotoxins/ Poultry/ Seed/ Spain/ Susceptibility/ reprint.

Haque, A.; Hossain, M.; Khan, J. K.; Kuo, Y.-H., and Lambein, F. (1994). **New findings and symptomatic treatment for neurolathyrism, a motor neuron disease occurring in North West Bangladesh**. Paraplegia **32**:193-195.

Neurolathyrism is a form of spastic paraparesis caused by the neuroexcitatory amino acid 3-N-oxalyl-L-2,3-diaminopropanoic acid (_-ODAP) present in the seeds and foliage of Lathyrus sativus. Tolperisone HCl, a centrally acting muscle relaxant, has been shown to reduce significantly the spasticity in neurolathyrism patients. Sporadic occurrence of HTLV-1 infection (0.9%) and of osteolathyrism was found among the neurolathyrism patients. Osteolathyrism is linked to the consumption of the green shoots of Lathyrus sativus.

Source: reprintDE; reprinted with permission. Copyright (1994) Stockton Press

Lathyrism viral infection/ HTLV-1 lathyrism/ Tolperisone lathyrism treatment/ Symptomatic treatment lathyrism/ Muscle relaxant lathyrism treatment/ Lathyrism treatment/ Lathyrism Bangladesh/ Bangladesh lathyrism/ Osteolathyrism Bangladesh/ Bangladesh ODAP/ Neurology Lathyrus sativus/ Osteolathyrism/ Amino acids/ Bangladesh/ HTLV/ Infection/ Lathyrism/ Lathyrism motor neurons/ Lathyrism treatment Motor neurons/ Muscles/ Neuroexcitatory/ Neurolathyrism/ Neurons/ ODAP/ Paraplegia/ Seed/ Shoots/ Spasticity/ Spastic paraparesis/ reprint.

Lambein, F.; Haque, R.; Khan, J. K.; Kebede, N., and Kuo, Y.-H. (1994). **From soil to brain: Zinc deficiency increases the neurotoxicity of Lathyrus sativus and may affect the susceptibility for the motorneurone disease neurolathyrism.** Toxicon **32** (4):461-466 (author affiliation: Laboratory of Physiological Chemistry, Faculty of Medicine, University of Ghent, Ledeganckstraat 35, B-9000 Gent, Belgium)

Zinc deficiency and oversupply of iron to the roots of grass pea (Lathyrus sativus) induce increases in the content of the neurotoxin beta-L-ODAP (3-oxalyl-L-2,3-diaminopropanoic acid) in the ripe seeds. The transport of zinc to the shoots is enhanced by the addition of beta-L-ODAP. The neurotoxin of Lathyrus sativus is proposed to function as a carrier molecule for zinc ions. Soils, depleted in micronutrients from flooding by monsoon rains (Indian subcontinent) or otherwise poor in available zinc and with high iron content (Ethiopian vertisols), may be responsible for higher incidence of human lathyrism, one of the oldest neurotoxic diseases known to man. A role for brain zinc deficiency in the susceptibility for lathyrism is postulated.

Source: reprintDE

Lathyrus sativus Zinc/ Zinc deficiency/ Nutrient manipulation Zinc/ Lathyrism susceptibility/ ODAP Zinc/ Soil Zinc/ Brain Zinc/ Neurology Lathyrism zinc/ Zinc lathyrism/ Zinc/ Waterlogging/ Soil/ Lathyrus sativus/ Brain/ Chemistry/ Deficiency/ Ethiopia/ Flooding/ Belgium/ Heavy metals/ Incidence/ India/ India L. sativus/ India lathyrism/ Iron/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism India/ Humans/ Metals/ Motor neurons/ Neurolathyrism/ Neurons/ Neurotoxicity/ Neurotoxins/ Nutrients/ ODAP/ Roots/ Seed/ Shoots/ Susceptibility/ Trace elements Vertisols/ Soil vertisol/ Water/ reprint.

Lambein, F.; Wouters, G.; Haque, A.; Hussain, M., and Yusul, H. K. M. (1994). **Recent progress in the Bangladesh-Belgium Inter-University Project**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 127-139.

Source: reprintDE

INILSEL/ Lathyrus sativus research Belgium/ Lathyrus sativus research Bangladesh/ Lathyrus sativus/ Bangladesh/ Ethiopia/ Belgium Lathyrism Bangladesh/ Lathyrism Ethiopia/ reprint.

Miller, S. E. (1994) **Aspects of glutamatergic function in astrocytes: glutamine synthetase regulation and metabotropic glutamate receptors** [PhD thesis]: University of California, Irvine, 157 pp.

The traditional view that astrocytes are passive support cells has begun to give way to a new consensus that these cells have dynamic roles in development, in the response to injury and disease, and in chemical and electrical signalling. In this context, this dissertation examines two aspects of astrocyte glutamatergic function using cultured cortical astrocytes as the model system. First, the effects were examined of exogenously applied excitatory amino acids on glutamine synthetase (GS), a key enzyme in glutamate metabolism. Two excitatory amino acids were identified which induced GS activity: $/beta$-N-Oxalyl-L-$/alpha,/beta$-diaminopropionic acid ($/beta$-L-ODAP), the putative Lathyrus toxin, and the metabotropic glutamate receptor (mGluR) agonist 1-aminocyclopentane-trans-1,3-dicarboxylic acid (trans-ACPD). The abilities of these compounds to induce GS activity were concentration-dependent, stereoselective, and could be reduced by the protein translation inhibitor cycloheximide. The possible significance of these alterations in GS activity for the regulation of glutamate homeostasis is discussed. The ability of the mGluR agonist trans-ACPD to increase GS activity suggested that mGluRs might have important roles in astrocyte function and led to the second series of studies which examined mGluR signal transduction and its regulation in astrocytes. The presence of two metabotropic signal transduction pathways for glutamate was demonstrated: stimulation of phosphoinositide hydrolysis and inhibition of cyclic AMP accumulation. The antagonist $ alpha$-methyl-4-carboxyphenylglycine was shown to block stimulation of phosphoinositide hydrolysis but not inhibition of cyclic AMP accumulation, providing a means to pharmacologically dissociate these two pathways. The glutamate transport inhibitor, L-trans-2,4-pyrrolidine dicarboxylic acid, was shown to also be an mGluR agonist in astrocytes and was particularly effective at reducing cyclic AMP accumulation. The phosphoinositide pathway was modifiable according to the chemical conditions of the culture environment. When astrocytes were cultured in a serum-free defined medium, trans-ACPD produced much larger stimulations of phosphoinositide hydrolysis than had been estimated in previous studies using conventional culture techniques. This increased stimulation appeared to be selective for mGluR agonists and was accompanied by a large increase in the expression of the mGluR5 subtype, as determined by Western immunoblotting. Further studies in serum-free culture revealed that both trans-ACPD-stimulated

phosphoinositide hydrolysis and mGluR5 expression could be increased by previous exposure of the astrocytes to basic fibroblast growth factor, epidermal growth factor, or transforming growth factor-$/alpha$.
Lathyrism/ ODAP toxicity mechanism/ Glutamates receptors/ Glutamine synthetase regulation/ Biochemistry/ Neurology/ Nerve cells Astrocytes/ Amino acids/ California/ cAMP/ Cycloheximide/ Dissertations/ Distribution plants/ Environment/ Enzymes/ Epidermis/ Excitatory amino acid/ Glutamates/ Glutamine/ Hydrolysis/ Lathyrism Biochemistry/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism serum Lathyrus toxicity/ Mechanisms toxicity/ Metabolism plant/ Models/ Nerves/ ODAP/ Protein/ Receptors/ Regulation/ Toxicity ODAP/ Toxicity mechanism ODAP/ Toxicity/ Toxin.

Misra, U. K. and Pandey, C. M. (1994). **H reflex studies in neurolathyrism.** Electroencephalography and Clinical Neurophysiology **93** (4):281-285 (author affiliation: Misra Uk Sanjay Gandhi Postgrad Inst Med Sci Dept Neurol Post Box 375 Lucknow Uttar Pradesh IndiaSanjay Gandhi Postgrad Inst Med Sci Dept Biostat Lucknow Uttar Pradesh India)
Sixteen patients with lathyrism, age ranging between 18 and 55 years and duration of illness between 2 and 25 years, underwent H reflex studies with the aim of studying motor neurone excitability. The patients had marked spasticity (Ashworth score ranging between 2 and 5) and mild to moderate leg weakness. Knee and ankle reflexes were exaggerated in all and the plantar response was extensor in 14 patients. The H reflex abnormalities included increased HM ratio indicating increased motoneurone excitability, significant lack of vibratory inhibition indicating altered transmission in the premotoneuronal portion of the H reflex pathway, and lack of reciprocal inhibition ($P < 0.01$). These H reflex abnormalities were not related to spasticity, weakness, clonus or plantar response. The H reflex recovery curve in 6 patients revealed increased excitability throughout the recovery curve. The secondary facilitation started and peaked slightly earlier than normal, and the late depression was not marked indicating change in excitability of motoneurones or of interneurones. [References: 21].
Source: Copyright Current Contents
H Reflex/ Spasticity/ Paraplegia/ Motor neuron excitability/ Lathyrism/ Neurology/ Age/ Clinical neurophysiology/ Electroencephalography India/ India Uttar Pradesh/ India lathyrism/ Lathyrism India/ Motor neurons/ Neurolathyrism/ Neurons/ Reflexes/ Transmission/ UK/ Uttar Pradesh.

Misra, U. K. and Sharma, V. P. (1994). **Peripheral and central conduction studies in neurolathyrism.** Journal of Neurology, Neurosurgery and Psychiatry **57**:572-577 (author affiliation: Dept of Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow-226 001, India)
To study the involvement of motor and sensory pathways in neurolathyrism, 19 patients with lathyrism from Unnao, India, where lathyrism is endemic, were studied. The mean age of the patients at the time of the onset of illness was 35.8 (range 18-70) years. The mean duration of illness was 15.6 (range 2-30) years. The clinical picture comprised walking difficulty due to stiffness and mild weakness in all 19 patients, cramps in the legs in five, frequency or urgency of micturition in five, and flexor spasms in three. There was pronounced leg spasticity with a mean Ashworth score of 4.1 (range 2.9-5). Central motor conduction to the tibialis anterior muscle (CMCT-TA) was slow in 14 of the 17 patients (21 sides). Slowing of peripheral motor nerve conduction, although less pronounced, was significant in the upper limb in four and in the lower limb in seven sides. The tibial somatosensory evoked potentials were normal and peroneal nerve conduction was marginally impaired. Values for CMCT-TA correlated with the degree of spasticity ($p < 0.02$) whereas weakness, crossed adductor reflexes, and clonus did not. The wide variability of CMCT-TA in lathyrism may be due to involvement of different types of fibres. Large diameter fibre involvement may cause pronounced slowing. Small diameter fibre involvement could produce appreciable spasticity and mild weakness but a lesser degree of slowing or even normal conduction.
Source: Lambein_95_5
Lathyrus/ Lathyrism/ Study of patients/ India Lathyrism/ Lathyrism India/ Symptoms lathyrism/ Neurology/ Lathyrism symptoms/ Age Endemic/ Fibre/ India/ Muscles/ Nerves/ Neurolathyrism/ Peripheral/ Reflexes/ Spasm/ Spasticity.

Moges, G. (1994). **Possibilities of flow-injection immobilised enzyme-based assay for beta-N-oxalyl-L-alpha,beta-diaminopropionic acid**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 97-104.
A successful program of eradicating lathyrism depends primarily on the reliability of measuring ODAP, a neurotoxin found in the seeds of Lathyrus sativus. The present methods of assay for ODAP are slow and do not distinguish the beta-isomer from the nontoxic alpha-form. One approach towards specificity in analysis is to use appropriate enzymes that catalyse the reactions of biomolecules. This presentation examines enzymes that may be used to catalyse the reactions of ODAP and its products, with emphasis on analytical potentials. Rapid assays can be developed by using immobilised (insolubilised) enzyme reactors in flow-injection analysis (FIA) and in post-column detections for high performance liquid chromatography (HPLC). Some FIA results

in measuring pyruvate and ammonia (products of a two-step reaction of ODAP) with immobilised L-lactate dehydrogenase (LDH) and L-glutamate dehydrogenase (GluDH) reactors are discussed.
Source: reprintDE
Enzyme catalysis/ Flow injection analysis/ ODAP/ Enzyme based assay ODAP/ ODAP enzyme assay/ ODAP analysis/ Lathyrus sativus Ammonia/ Bioassay/ Chromatography/ Enzymes/ Ethiopia/ Glutamates/ HPLC/ HTLV/ Injections/ Isomerism ODAP/ Isomerism/ Lactate dehydrogenase/ Lactate/ Lathyrism Bioassay/ Lathyrism Ethiopia/ Lathyrism viral infection/ Neurotoxins/ ODAP isomerism/ Seed/ reprint.

Negere, A. and Mariam, S. W. (1994). **An overview of grass pea (Lathyrus sativus) production in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 67-72.
Source: reprintDE
Lathyrus sativus production Ethiopia/ Ethiopia L. sativus production/ Lathyrus sativus/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ reprint.

Nunn, P. B. (1994). **What molecular mechanisms cause the signs and symptoms of neurolathyrism?** In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 36-43.
Source: reprintDE
Lathyrism mechanisms?/ Neurology/ Lathyrism symptoms/ Ethiopia/ Lathyrism/ Lathyrism Ethiopia/ Lathyrism mechanisms/ Mechanism Molecular/ Neurolathyrism/ Symptoms lathyrism/ reprint.

Soyka, D. (1994). **Toxic encephalopathies.** Nervenheilkunde **13** (4):149-154 (author affiliation: Soyka D Christian Albrechts Univ Kiel Neurol Klin Niemannsweg 147 D-24105 Kiel Germany)
[German] Many substances may cause both toxic lesions and clinical syndromes related to the central nervous system. In this paper some aspects of pathogenesis as well as diagnostic problems are reviewed. In particular intoxications with some metals and metalloids, gases and organic compounds including solvents are considered. [References: 21].
Source: Copyright Current Contents
Neurotoxicology/ Encephalopathies/ Pathogenesis/ Diagnostic problems/ Nervous-system/ Lathyrism/ Disease/ Lead/ Review.

Tadasse, D. (1994). **Grass pea (Lathyrus sativus): Genetic resources conservation and utilization in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 61-66.
Source: reprintDE
Ethiopia L. sativus genetic resources/ Genetic resources L. sativus Ethiopia/ Lathyrus sativus/ Agriculture/ Genetic resources/ Conservation Ethiopia/ Lathyrism Ethiopia/ Genetic resources L. sativus/ reprint.

Tekle Haimanot, R.; Kidane, Y.; Wuhib, E.; Kassina, A.; Endeshaw, Y.; Alemu, T., and Spencer, P. S. (1994). **The epidemiology of lathyrism in Ethiopia**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 1-9.
Source: reprintDE
Lathyrism Ethiopia/ Ethiopia lathyrism/ Lathyrism epidemiology/ Epidemiology lathyrism/ Ethiopia/ Lathyrism/ reprint.

Tiwari, K. R. (1994) **Inheritance of the neurotoxin beta-N-oxalyl-L-alpha,beta-diaminopropionic acid (ODAP) in grass pea (Lathyrus sativus L.) seeds** [MSc thesis]. Winnipeg: Dep. Plant Science, University of Manitoba, 144 pp.
Excellent study and comprehensive review, well worth reading. F2 progeny segregated over entire parental range. ODAP biosynthesis is inherited quantitatively. Cytoplasmic factors appear to be involved. Low x low ODAP crosses resulted in low ODAP progeny. Young seeds contain higher ODAP levels than fully matured seeds! Grass pea (Lathyrus sativus L.) is an important food, feed and fodder legume drought resistant crop. A strong epidemiological association is known to exist between consumption of grass pea and lathyrism. A neurotoxin, $/beta$-N-Oxalyl-L-$/alpha,/beta$-diaminopropionic acid (ODAP) has been identified to be the causative principle. This study was undertaken to investigate the mode of inheritance of the neurotoxin, a prerequisite for the development of neurotoxin free or low neurotoxin lines. Five grass pea lines with low to high ODAP concentration were inter-crossed in all possible combinations (both crosses and reciprocals). Parents, F$/sb1$ and F$/sb2$ progenies were evaluated under field condition and ODAP analyzed by ortho-phthalaldehyde spectrophotometric method. Many of the progenies of low x low ODAP crosses were found to be low in ODAP concentration which indicated that the low ODAP lines shared some genes in common for seed ODAP content. However, wider variation of ODAP in F$/sb2$ progenies as compared to

parental and F$/sb1$ progenies, suggested the presence of different modifier genes between lines. The F$/sb1$ progenies of the low ODAP x high ODAP crosses were intermediate in ODAP concentration which indicated lack of complete dominance either by low or high ODAP. The F$/sb2$ progenies segregated covering the entire parental range. The continuous variation, together with very close to normal distribution of the F$/sb2$ population both of low x low and low x high ODAP, crosses indicated ODAP to be quantitatively inherited. Reciprocal crosses produced different results in some cases indicating a maternal effect on ODAP concentration. Broad sense heritability of ODAP concentration was estimated to be in the range of 17 to 93%.
Source: reprintDE.
ODAP genetics/ Breeding ODAP/ ODAP inheritance/ Genetics ODAP/ Genetics L. sativus/ Lathyrus sativus genetics/ Genetics cytoplasmic factors/ ODAP biosynthesis cytoplasm/ Lathyrus sativus review/ Forage/ Lathyrus sativus/ Agriculture/ Biosynthesis/ Canada/ Climate/ Drought Feed/ Feed Lathyrus sativus/ Fodder/ Food/ Genes/ Genetics/ Heritability/ Lathyrism review/ Manitoba/ Maternal/ Neurotoxins/ O phthalaldehyde/ ODAP/ ODAP biosynthesis/ Population/ Resistance/ Review/ Seed/ reprint.

Trent, M. B. and Boor, P. J. (1994). **Vascular amine oxidase activities during synergistic vasculotoxicity.** Toxicology **89** (1):67-77 (author affiliation: Boor Pj Univ Texas Med Branch Dept Pathol F-05 Galveston, Tx 77555 Usa)
Allylamine (AA) and beta-aminopropionitrile (beta APN) are well known vascular toxins with a demonstrated synergistic toxic effect, i.e. given together they cause extensive smooth muscle cell necrosis of the aortic media. In this study, we investigated the possibility that the enzymes involved in the separate toxicity of AA (semicarbazide-sensitive amine oxidase, or SSAO) and beta APN (lysyl oxidase, or LyO), could be the target(s) of their synergistic toxicity. Adult male Sprague-Dawley rats were given AA alone (AA), 100 mg/kg day, beta APN alone (beta APN), 1 g/kg/day, or both chemicals (AA + beta APN) by gavage for 1, 2, 5 or 10 days. SSAO and LyO were assayed in aorta, lung, and bone. SSAO activity in aortas of rats treated with AA + beta APN showed a maximal decrease (40%) at 10 days; more moderate depression of SSAO was seen in lung and bone, LyO changes were most marked in aorta, where activities were consistently and markedly depressed in all rats receiving beta APN (either alone or in combined treatment). Similarly, the lung and bone LyO activity was depressed at all time points in rats receiving beta APN, but to an apparently lesser degree than in aorta. The most striking changes in in vivo enzyme activities were seen in the aorta, the major target organ in this model. No synergistic effect of the two toxins was seen in the depression of LyO enzyme activity, since there was no difference in the degree of enzyme inhibition present between rats given beta APN alone or AA + beta APN, indicating that inhibition of this enzyme is mainly due to the effect of beta APN. We suggest that AA is the primary toxin in this synergistic vasculotoxic effect. It is likely that some effect of beta APN on AA metabolism or detoxification mechanisms results in synergism. [References: 26].
Source: Copyright Current Contents
Semicarbazide-sensitive amine oxidase/ Lysyl oxidase/ Allylamine/ Beta-aminopropionitrile/ Aorta/ Vascular toxicity/ Smooth-muscle cells Benzylamine oxidase/ Lysyl oxidase/ Allylamine cardiotoxicity/ Beta-aminopropionitrile/ Rat/ Toxicity Lathyrism/ Acrolein/ Invitro.

Tylleskär, T.; Rwiza, H. T.; Banea, M.; Howlett, W. P.; Aquilonius, S.-M.; Persson, L.-A., and Rosling, H. (1994). **Similarities between Konzo and lathyrism suggest a common pathogenetic mechanism**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 26-32. (author affiliation: International Child Health Unit, Department of Neurology, University Hospital, Uppsala, Sweden).
Source: reprintDE
Lathyrism chronic Cassava toxicity/ Lathyrus/ Lathyrism/ Konzo/ Pathogenic mechanism/ Cassava toxicity lathyrism similarities/ Neurology Cassava toxicity/ Child/ Ethiopia/ Lathyrism Ethiopia/ Lathyrism mechanisms/ Lathyrus toxicity/ Humans/ Manihot esculenta/ Cassava Mechanisms toxicity/ Sweden/ Toxicity/ Uppsala/ reprint.

Urga, K.; Fite, A., and Gebre Tsadik, M. (1994). **Influence of processing methods on cooking time and nutritional quality of grass pea**. In: Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. (Eds). **The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia**, New York: Third World Medical Research Foundation, pp. 105-118.
A simple and convenient procedure has been developed for the preparation of quick-cooking grass pea seeds. When cooked in boiling water, salt solution and wood ash filtrate, pre-soaked grass pea seeds tenderised within 20 and 40 min, respectively. This corresponds to a reduction of 96 % and 84%, respectively, of the time required to cook untreated grass pea seeds. The process also resulted in leaching of solids to the soaking solutions; these increased with the hydration time. During cooking, leaching of solids to the cooking water decreased with the drop in cooking time. Hydration of grass pea seeds prior to cooking also gave a higher drained weight than without hydration. The process also resulted in loss of minerals, protein, phytate and ODAP. The cooked, quick-cooking seeds, however, had a smooth uniform texture, excellent whole-seed appearance, and a pleasing and acceptable flavour. The quick-cooking process thus should find applications in

parts of Ethiopia which are usually fuel-deficient and where dry grass pea seeds are produced as a stable and high protein food commodity.
Source: reprintDE
Lathyrus sativus processing/ Lathyrus sativus cooking/ ODAP/ Lathyrus sativus/ Ash/ Cookery/ Ethiopia/ Flavour/ Food/ Food processing Food processing L. sativus/ Fuel/ Lathyrism/ Lathyrism Ethiopia/ Mineral/ Phytates/ Processing/ Processing methods L. sativus/ Protein/ Quality Seed/ Soaking/ Water/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1994). **Neuroprotective effect of free radical scavengers on beta-n-oxalylamino-l-alanine (BOAA)-induced neuronal damage in rat hippocampus.** Neuroscience Letters **182** (2):159-162 (author affiliation: Willis Cl Inst Psychiat Dept Neurol De Crespigny Pk London Se5 8af EnglandInst Psychiat Dept Neurosci London Se5 8af EnglandUniv London Kings Coll Div Biomed Sci London Wc2r 2ls England)
The neurotoxin beta-N-oxalylamino-L-alanine (BOAA), found in Lathyrus sativus seeds, is thought to be the causative agent of neurolathyrism. We have investigated the neuroprotective effects of free radical scavengers on BOAA-induced toxicity following focal injection (1 mu l) of BOAA and comparing the pathological outcome with the effects of injections of alpha-amino-3-hydroxy-5-methyl-isoxazole-4-propionate (AMPA), kainate (KA) or N-methyl-D-aspartate (NMDA) into the dorsal hippocampus of male Wistar rats. Cellular damage was assessed histologically. BOAA (50 nmol) induced a highly selective pattern of hippocampal damage identical with that seen with AMPA (1 nmol). BOAA-induced neurotoxicity, but not AMPA, KA (0.5 nmol) or NMDA (25 nmol)-induced neurotoxicity, was prevented in a dose-dependent manner by focal co-injection of four potential free radical scavengers; dimethyl sulphoxide (DMSO) (1750-7000 nmol), dimethylthiourea (DMTU) (8000 nmol), dimethylformamide (DMF) (7000 nmol) and mannitol(1000 nmol). These findings suggest that hippocampal damage induced by BOAA involves an interaction between AMPA receptors and free radicals. [References: 28].
Source: Reprinted with permisssion (1994) Elsevier Science Ireland Ltd.
ODAP/ DMSO/ Free Radical/ Neurotoxicity/ Neurolathyrism/ Motor neuron disorder/ Excitatory Amino Acid/ Hippocampus/ ODAP toxicity mechanism/ Toxicity ODAP/ Free radical scavengers/ Lathyrism/ Neurology/ Biochemistry/ Lathyrus sativus/ Beta Alanine analogs and derivatives/ Amino acids/ Amino acids toxicity/ AMPA receptors/ Aspartic acid/ England/ Injections/ Kainic acid/ Lathyrism Biochemistry Lathyrism hippocampus/ Lathyrism mechanisms/ Lathyrism ODAP toxicity/ Lathyrism rats/ Lathyrus toxicity/ Males/ Mechanisms toxicity Motor neurons/ Neurons/ Neurotoxins/ NMDA/ Prevention lathyrism/ Lathyrism prevention/ Rats/ Receptors/ Rodents/ Seed/ Toxicity L. sativus/ Toxicity L. sativus mechanisms/ Toxicity mechanism ODAP/ Toxicity/ UK.

Wuhib, E.; Tekle Haimanot, R.; Kassina, A.; Kidane, Y., and Alemu, T. (1994). **Survey of grass pea preparation and general dietary intake in rural communities**. Abegaz, B. M.; Tekle Haimanot, R.; Palmer, V. S., and Spencer, P. S. The grass pea and lathyrism. Proceedings of the second international Lathyrus/lathyrism conference in Ethiopia, in Addis Ababa, Ethiopia. Published in New York: Third World Medical Research Foundation, pp. 119-126. ISBN: 0-9617775-3-2.
Ethiopian Nutrition Institute, Addis Ababa, Ethiopia; and Faculty of Medicine, Addis Ababa University Addis Ababa, Ethiopia (RTH & TA)Grass pea is a leguminous crop widely consumed in the central highlands of Ethiopia. It is known to have a toxic effect that can manifest as a medico-social problem in a large number of the population. A comprehensive study under the title of 'The Improvement of Lathyrus sativus and the Eradication of Lathyrism' has been conducted by the medico-nutrition group. As part of this study, a household survey on grass pea preparation and general dietary study has been conducted in Dembia and Fogera sub-districts in Gondar administrative region in 1989. The main purpose of the survey was to study methods used in preparation of grass pea for consumption and at the same time, to assess feeding patterns and food intake of the communities. Two farmers associations were selected, namely Shina (grass pea growing) and Muntura (non-grass pea producing). Random samples of 110 and 114 households from Shina and Muntura Farmers' Associations were respectively selected. Information was collected using a pre-tested questionnaire. Standard dietary survey procedure was followed for the dietary study. Information was collected by 10 trained female enumerators under close supervision. Processed data indicate that grass pea is prepared into shiro, nifro, kollo and kitta for consumption. The grass pea is washed whole or split and heat treated in one way or another before preparing into the desired dish. Approximately 80% of the households surveyed have two main meals during the day. The main dishes are thin leavened bread, injera, and sauce, wot. The injera is prepared from finger millet alone or mixed with teff, corn and sorghum. The sauce is prepared from grass pea alone or grass pea mixed with chickpeas.
Source: Lambein_95_5; reprintDE
Lathyrism/ Lathyrism Ethiopia Survey/ Lathyrus sativus preparation/ Lathyrus sativus recipes/ Homeeconomics/ Socioeconomics/ Ethiopia Lathyrus food/ Dietary intake L. sativus Ethiopia/ Human consumption L. sativus Ethiopia/ Economic botany L. sativus/ Culinary aspects INILSEL/ Lathyrus sativus/ Agriculture/ Bread/ Cicer arietinum/ Diet/ Dietary intake/ Economic botany/ Ethiopia/ Feeding/ Female/ Food Heat/ Household/ Human consumption/ Dietary/ Intake/ Lathyrism Ethiopia/ Lathyrism nutrition/ Lathyrus toxicity/ Humans/ Mixtures Nutrition/ Nutrition surveys/ Population/ Rural/ Sorghum/ Surveys/ Toxicity L. sativus/ Toxicity/ reprint.

Ahmad, K. and Jahan, K. (1995). **The role of vitamin C in the prevention of neurolathyrism and detoxification of Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 278.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh lathyrism/ Bangladesh nutrition/ Vitamin C/ Vitamin C lathyrism/ Vitamin C neurolathryism Vitamins/ Lathyrus sativus/ reprint.

Amruth, R. P. and Bhat, R. V. (1995). **Lathyrism in Bidar and Medak districts of South India**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 239-242.
Source: reprintDE
Lathyrism/ Neurolathyrism/ India/ Andhra Pradesh/ Surveys/ Lathyrism epidemiology/ Epidemiology lathyrism/ Lathyrus sativus/ reprint.

Azzi, G.; Safars, M.; Viljanentarifa, E.; Voros, E., and Robert, A. M. (1995). **Effect of the benzquercin treatment on the connective tissue of lathyritic mice - a study by optical and transmission electron microscopy [french].** Pathologie Et Biologie **43** (5):448-460 (author affiliation: Azzi G Univ Paris 07 Fac Sci Equipe Tissu Conjonctif Biol Cellulaire Lab 2 Pl Jussieu F-75251 Paris 05 France)
Vascular pathology is characterized by important alterations of some vessel macromolecular constituants, such as fibrous proteins, collagens and elastin. The purpose of our study was to establish the activity of benzquercin treatment on such alterations of the vascular wall. As experimental model we used lathyrism induced in mice by chronic administration of beta-amino-propionitril (beta-APN). This compound prevents crosslink-formation in elastin and collagen and provokes a disorganisation of the structure and an alteration of the physiological functions of the vascular wall. The connective tissue of the skin is also impaired simultaneously with that of the blood vessels. We compared by optical and transmission electron microscopy the morphological structure of the aorta and the skin of 3 groups of mice : a normal control group, an other which only received the beta-APN alone and a third one which received the beta-APN and the benzquercin treatment. The second group, injected with beta-APN without treatment, showed important alterations of the structure of the aorta as well as of the skin. Both fibrous proteins, collagen and elastin were concerned by these alterations, the consequence of which was an increase of the permeability of the aorta wall demonstrated with the horse-radish peroxydase as a tracer. The third group, injected with beta-APN and treated with the benzquercin, showed much less morphological disorders than the untreated group and the vascular permeability was also close to normal controls. These results are in favour of a corrective effect of benzquercin treatment on fibrous proteins of connective tissue and may represent one of the components of the therapeutic effects observed in the clinical trials of this drug. [References: 19].
Source: Copyright Current Contents
Benzquercin/ Beta-apn/ Lathyrism/ Crosslinks/ Reticulation of collagen/ Reticulation of elastin/ Vascular permeability/ Procyanidolic oligomers.

Bell, E. A. (1995). **Complementary approaches to the improvment of Lathryus sativus and the elimination of lathyrism**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 249-253.
Source: reprintDE
Poverty/ Genetics/ Malnutrition/ ODAP/ Lathyrus sativus/ Neurolathyrism/ Australia/ Canada/ Lathyrus sativus low ODAP/ Outcrossing Biochemistry/ reprint.

Briggs, C. J.; Campbell, C. G., and Castell, A. G. (1995). **Analysis of grass pea, Lathryus sativus, and its evaluation as a component of animal feed**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 81-84.
Use of Lathyrus sativus (L) seed as a component of pig feed was evaluated. Effects on growth, carcass quality and major organs were assessed. There was some reduction in rate of weight gain, but results with up to 20% lathyrus in feed were acceptable for commercial use.
Source: reprintDE
Pigs/ ODAP analysis/ Carcass quality/ Nutrition animal/ Feed/ Lathyrus sativus feed/ Lathyrus sativus/ Canada/ reprint.

Campbell, C. G. and Deshpande, S. S. (1995). **Breeding grass pea (Lathyrus sativus) for increased nutritive value**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 167-172.
Source: reprintDE
Phenols/ Polyphenols/ Protease inhibitor/ Protease inhibitors L sativus/ Tannins/ Trypsin inhibitor/ Amylase inhibitor/ Chymotrypsin inhibitor ODAP/ Nutrition/ Nutritive value/ Lathyrus sativus/ Canada/ Breeding/ Lathyrus sativus low ODAP/ reprint.

Chowdhury, B.; Hussain, M., and Wouters, G. (1995). **Comparative study of the OPT method for the neuotoxin ODAP as modified by various laboratories**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 284.
Source: reprintDE
ODAP/ O Phthalaldehyde/ ODAP analysis/ ODAP chemistry/ Analysis ODAP/ Lathyrus sativus/ reprint.

Chowdhury, S. D. (1995). **Lathyrus in poultry feeding - some recent findings**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 235-238.
Source: reprintDE
Poultry/ Lathyrus sativus/ Feed/ Lathyrus pusillus/ Lathyrus odoratus/ Lathyrus hirsutus/ BAPN/ Beta aminopropionitrile/ ODAP/ Review reprint.

Cohn, D. F. (1995). **Are other systems apart from the nervous system involved in human lathyrism?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 101-102.
Twenty five years of following lathyrism patients, who were exposed in 1942 to the grass pea (Lathryus sativus), point to the fact that not only the central nervous system is involved, but the skeleton, the peripheral nerves and the cornea may also be affected in some patients. It is therefore suggested that the term Human Lathyrism Syndrome (HULAS) be coined for the condition in man.
Source: reprintDE
Osteolathyrism/ Neurolathyrism/ Skeleton/ Ukraine/ Israel/ Lathyrism/ Cornea/ Peripheral nervous system/ Human Lathyrism Syndrome Lathyrus sativus/ reprint.

Datta, A. (1995). **Strategy to develop transgenic Lathyrus with low level neurotoxin by recombinant DNA technology**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 173-176.
Source: reprintDE
Molecular biology/ Lathyrus sativus/ Lathyrus sativus genetics/ Lathyrus sativus low ODAP/ India/ Oxalate decarboxylase/ reprint.

De Bruyn A. and Nunn, P. B. (1995). **Involvement of an imidazolidine derivative during the rearrangement of the neurotoxin beta-ODAP**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 25-30.
Source: reprintDE
Isomerism/ Chemistry/ ODAP/ Alpha-ODAP/ ODAP chemistry/ Chemistry ODAP/ NMR/ Imidazolidine/ Lathyrus sativus/ reprint.

De Bruyn A.; Van Haver, D.; Nunn, P. B., and Abegaz, B. M. (1995). **Comparison of the experimental and calculated conformations of beta-ODAP**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 281.
Source: reprintDE
ODAP/ ODAP chemistry/ ODAP structure/ NMR/ NMR characteristics ODAP compounds/ Lathyrus sativus/ reprint.

Dibabe, A. (1995). **Grain yield and ODAP content of some grass pea cultivars in Ethiopia**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 139-143.
Source: reprintDE
ODAP screening/ Ethiopia/ Lathyrus sativus/ Ethiopia L. sativus/ Ethiopia L sativus improvement/ Ethiopia L. sativus genetic resources Lathyrus sativus Genetic resources screening/ Yield/ Yield L. sativus/ Genetic resources/ Genetic resources evaluation/ reprint.

Düsünceli, F. (1995). **Prospects for production of Lathyrus sativus and L. cicera in Southeast Anatolia in Turkey**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 131-137.
Source: reprintDE
Lathyrus sativus/ Lathyrus cicera/ Turkey/ Anatolia/ Forage/ Seed yield/ Agronomy/ Genetic resources evaluation/ ODAP screening/ Yield Yield fodder/ Yield L. sativus/ Yield L. cicera/ Genetic resources/ reprint.

Dwivedi, M. P. (1995). **Legal aspects of cultivation and consumption of Lathyrus sativus in India**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 51-54.
Source: reprintDE
Legislation/ Lathyrus sativus ban India/ India/ Lathyrus sativus/ reprint.

Enneking, D. (1995). **Post-harvest detoxification: the key to alternative Vicia grain legumes?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 85-92.
Vicia sativa, V. narbonensis, V. ervilia and V. articulata (syn. V. monantha) are well suited for Mediterranean dryland agriculture. The use of these species as grain legumes has been largely restricted to the supplemental feeding of ruminants and draft animals, and in times of famine, this use has sometimes been extended to human consumption. We have studied the unpalatability of V. villosa and V. narbonensis grain, using a porcine feed-intake bioassay. Two different antifeedant principles were isolated. The seed of V. villosa contains the toxic arginine analogue, canavanine1 and that of V. narbonensis the dipeptide gamma glutamyl S-ethenyl-cysteine2, which incidentally is analogous to the flavour precursor, gamma glutamyl S-prop-1-enyl-cysteine present in chives (Allium schoenoprasum)3. V. villosa is not a grain legume, but a forage crop. Other species, such as V. articulata and V. ervilia which do also contain canavanine in their seeds are used as grain legumes for supplemental feeding of ruminants. Their use as food for monogastric animals and humans is limited by the presence of canavanine. V. sativa contains the favism toxin, vicine, as well as the neurotoxic and antinutritional cyanoamino acids, ß-cyanoalanine and gamma glutamyl ß-cyanoalanine. The antinutritional non-protein amino acids in V. sativa and V. narbonensis can be inactivated by mild acid hydrolysis2. Under alkaline conditions, canavanine degrades to deamino-canavanine which is inactive in the bioassay1 Thus, in principle, the major undesirable non protein amino acids in Vicia spp. seeds, can be inactivated by either acidic or alkaline chemical processes. In view of the biological functions for these factors in the ecology of Vicia spp., it appears that post-harvest detoxification could well be the best long-term option for the sutainable development of these crops. Traditional utilisation practices and preparative methods for Vicia grain should now be assessed in detail for their effectiveness in minimising the ingestion of these factors whilst preserving their nutritive properties. Innovative application of this knowledge can reasonably be expected to provide the basis for the wider utilisation of Vicia spp. as grain legumes. 1. Enneking, D. Giles, L. C., Tate, M. E., Davies, R. L. (1993). L-canavanine: a natural feed-intake inhibitor for pigs (isolation, identification and significance) J. Sci. Food Agric. 61, 315-325 2. Enneking, D. 1994, The toxicity of Vicia species and their utilisation as grain legumes. PhD thesis. University of Adelaide, South Australia 3. Mattikala, E J. & Virtanen, A. I. (1962). A new g-glutamylpeptide, g-L-glutamyl-S-(prop-1-enyl)-L-cysteine, in the seeds of chives (Allium schoenoprasum). Acta Chem. Scand. 16, 2461-2462.
Source: reprintDE
Vicia spp toxicity/ Postharvest detoxification/ Vicia sativa/ Vicia narbonensis/ Vicia villosa/ Canavanine/ gamma glutamyl S-ethenyl-cysteine South Australia/ Famine foods/ Famine/ Malnutrition/ Antinutritional factors/ Forage/ Lathyrus sativus/ Bioassay/ NPAA gamma glutamyl peptides/ Agriculture/ Beta cyanoalanine/ Allium/ Amino acids/ Arginine/ Australia/ Chemistry/ Cysteine/ Detoxification/ Dissertations Distribution plants/ Dryland/ Ecology/ Favism/ Feed/ Feeding/ Feed ruminants/ Feed Vicia sativa/ Feed Lathyrus sativus/ Feed Lathyrus ochrus Flavour/ Food/ Gamma glutamyl peptides/ Gamma glutamyl beta cyanoalanine/ Grain legumes/ Pulses/ Human consumption/ Intake/ Isolation Lathyrism animals/ Lathyrism Bioassay/ Lathyrus ochrus/ Lathyrus toxicity/ Humans/ Mediterranean/ Monogastric/ Neurotoxins/ NPAA NPAA chemistry/ Peptides/ Pigs/ Postharvest/ Protein/ Ruminants/ Ruminant feed/ Ruminants L. sativus/ Seed/ Sulfur amino acids/ Toxicity L. sativus/ Toxicity/ Toxin/ Utilisation/ Vicia spp/ Vicia/ Vicia ervilia/ Vicia articulata/ Vicia monantha/ Vicine/ reprint.

Geda, A. K.; Pandey, R. L., and Agrawal, R. K. (1995). **Environmental influence on ODAP content in Lathyrus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 221-223.
Source: reprintDE
ODAP/ ODAP environmental variation/ India/ India L. sativus/ Lathyrus sativus/ Lathyrus sativus India/ Rabi/ IARI/ Lathyrus sativus low ODAP/ Environmental effects/ Environment x genotype/ reprint.

Gutierrez, J. F. and Vences, F. J. (1995). **Genetic and physiological studies in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 189-199.
Source: reprintDE
Genetics/ Physiology/ Lathyrus sativus/ Spain/ RAPD/ Isozymes/ HPLC/ ODAP/ Linkage analysis/ Lathyrus sativus low ODAP/ reprint.

Haque, A. and Hossain, M. (1995). **Role of tolperisone in lathyrism**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 119-126.
Source: reprintDE
Neurolathyrism/ Muscle relaxant lathyrism treatment/ Muscles/ Tolperisone lathyrism treatment/ Lathyrus sativus/ reprint.

Haque, A.; Hossain, M.; Lambein, F., and Bell, E. A. (1995). **Occurrence of osteolathyrism among neurolathyrism patients in Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 273.

60 of 500 neurolathyrism patients complained of bone pain and showed skeletal deformities. 2 of these were found to have skeletal damage (failure of fusion in both vertebral and iliac epiphyses). Of the 60, all were familiar with the consumption of seeds and green parts of Lathyrus sativus, the latter of which contain 2-cyanoethyl-isozazolin-5-one, a compound that chemically and metabolically can osteolathyrogen beta-aminopropionitrile.
Source: reprintDE
Osteolathyrism/ Neurolathyrism/ Bangladesh/ BAPN/ Isoxazolin-5-one/ Isoxazolin-5-one toxicity/ Beta aminopropionitrile/ Beta aminopropionitrile toxicity/ Lathyrus sativus/ reprint/ 2 Cyanoethylisoxazolin 5 one/ NPAA 2-(2-cyanoethyl)-3-isoxazolin-5-one.

Haque, A.; Hossain, M.; Wouters, G.; Kuo, Y. H., and Lambein, F. (1995). **Study on some socio-economic aspects of lathyrism patients in two North-Western districts of Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 63-68.
Source: reprintDE
Bangladesh economics/ Bangladesh/ Bangladesh L. sativus/ Bangladesh lathyrism/ Bangladesh nutrition/ Bangladesh poverty/ Bangladesh socioeconomics/ Socieconomics Bangladesh/ Socieconomics L. sativus/ Socioeconomic constraints/ Socioeconomic Factors/ Socioeconomics Socioeconomics Bangladesh/ Socioeconomics L. sativus/ Lathyrus sativus/ reprint.

Haque, A.; Kebede, N.; Kuo, Y. H.; Hussain, M., and Lambein, F. (1995). **Effect of nutrient elements and environmental factors on ODAP and other amino acids content in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 276.
Source: reprintDE
ODAP/ ODAP environmental variation/ ODAP Zinc/ ODAP drought stress/ Drought/ Drought stress/ Drought stress effect on ODAP/ Drought stress L. sativus/ Salinity/ Nutrient manipulation Zinc/ Nutrients/ Nutrition plant/ Lathyrus sativus/ reprint.

Haque, A.; Khan, J. K.; Wouters, G.; Hossain, M., and Lambein, F. (1995). **Low frequency of HTLV-1 antibodies in neurolathyrism patients in Bangladesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 283.
Source: reprintDE
Neurolathyrism/ HTLV/ HTLV 1/ HTLV-1 lathyrism/ Bangladesh/ Bangladesh lathyrism/ Lathyrus sativus/ reprint.

Haque, A.; Khan, J. K.; Wouters, G.; Hossain, M., and Lambein, F. (1995). **Study of HTLV-I antibodies in CSF and serum of neurolathyrism patients in Bangladesh.** Annales De La Societe Belge De Medecine Tropicale **75** (2):131-134
Neurolathyrism is a form of human spastic paraparesis related to the overconsumption of the legume Lathyrus sativus or grass pea (Khesari in Bangladesh) containing the neurotoxin 3-N-oxalyl-2,3-diaminopropanoic acid (beta-ODAP). The clinical symptoms of neurolathyrism are similar to those of Tropical Spastic Paraparesis, In order to eliminate the proposed causative agent of TSP (HTLV-I) as a potential cause of the symptoms ascribed to neurolathyrism, a total of 444 diagnosed lathyrism patients were screened for HTLV-I antibodies. 50 CSF and 394 serum samples were collected from male (415) and female (29) patients. Only 4 serum samples were found sere-positive for HTLV-I. This agrees with the assumption that overconsumption of beta-ODAP containing Lathyrus seeds, and not HTLV infection, is the causative agent for neurolathyrism.
Source: Reprinted with permission of the authors
Neurolathyrism/ Tropical Spastic Paraparesis/ HTLV 1/ Cerebrospinal Fluid/ ODAP/ Bangladesh lathyrism/ Neurology/ Lathyrus sativus Lathyrism symptoms/ Antibodies/ Bangladesh/ Female/ Belgium/ HTLV/ Immunology/ Infection/ Khesari/ Lathyrism/ Lathyrism Bangladesh Lathyrism cerebrospinal fluid/ Lathyrism serum/ Lathyrism viral infection/ Males/ Humans/ Neurotoxins/ Seed/ Spasticity/ Spastic paraparesis Symptoms lathyrism/ Tropics.

Haque, R.; Kuo, Y. H., and Lambein, F. (1995). **Effect of zinc and iron on the biosynthesis of ODAP in callus tissue of Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 282.
Fe 2+ and Zn 2+ ions can modulate the biosynthesis of ODAP.
Source: reprintDE
ODAP/ ODAP Zinc/ Tissue culture/ Callus/ Callus culture/ Zinc/ Iron/ Lathyrus sativus/ Lathyrus sativus biochemistry/ Biochemistry Biosynthesis ODAP/ Biosynthesis/ ODAP biosynthesis/ reprint.

Hussain, M. and Chowdhury, B. (1995). **Agro-ecological factors affecting the concentration of beta-N-oxalyl-alpha,beta-diaminopropionic acid (ODAP) in Lathyrus sativus seed**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 201-209.
Source: reprintDE

Environmental effects/ Environment x genotype/ Salinity/ Water stress/ ODAP/ ODAP environmental variation/ Fertiliser/ Micronutrients Trace elements/ Water/ Water relations/ Lathyrus sativus/ reprint.

Ikegami, F.; Kuo, Y. H.; Lambein, F., and Murakoshi, I. (1995). **Biosynthesis in vitro of some Lathyrus toxins**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 1-13.
Source: reprintDE
Lathyrus sativus/ NPAA biosynthesis/ In vitro/ Biosynthesis/ Isoxazolin-5-one/ Biochemistry L. sativus/ Toxin/ Toxin biosynthesis/ reprint.

Junaid, M. A.; Jain, R. K., and Rao, S. L. N. (1995). **Binding of ODAP to chick synaptic membranes**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 31-40.
Source: reprintDE
Synapses/ Synaptic Membranes metabolism/ ODAP receptors/ Neurology/ Biochemistry/ Lathyrus sativus/ reprint.

Kaul, A. (1995). **Concluding remarks and recommendations**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 269-271.
Source: reprintDE
Strategy/ Recommendations/ Lathyrus sativus/ reprint.

Kebede, N.; Kuo, Y. H.; Khan, J. K., and Lambein, F. (1995). **Influence of nutrient status for cultivation of Lathryus sativus and level of the neurotoxin ODAP: A link between environment and toxicity?** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 211-214.
Source: reprintDE
Environmental effects/ Environment x genotype/ Sulfur/ Cysteine Synthase/ ODAP environmental variation/ Belgium/ Lathyrus sativus Toxicity L. sativus/ Toxicity ODAP/ Toxicity/ reprint.

Khan, J. K.; Kebede, N.; Kuo, Y. H., and Lambein, F. (1995). **High-performance liquid chromatographic separation of the toxins and some non-protein amino acids in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 69-72.
Source: reprintDE
NPAA analysis/ NPAA chemistry/ Isoxazolin-5-one/ HPLC/ ODAP/ Lathyrus sativus chemistry/ Chemistry/ Toxin/ Lathyrus sativus/ reprint.

Khan, J. K.; Kuo, Y.-H.; Haque, A., and Lambein, F. (1995). **Inhibitory and excitatory amino acids in cerebrospinal fluid of neurolathyrism patients, a highly prevalent motorneurone disease**. Acta Neurologica Scandinavica **91**:506-510.
Data are presented which suggest a disturbance of amino acid metabolism caused through the consumption of L. sativus/ and associated factors. Glu, Tau, Gly were higher in lathyrism patients.
Source: reprintDE; reprinted with permission Copyright 1995 Munksgaard Publishers, Copenhagen
Cerebrospinal fluid amino acid analysis/ Lathyrism CSF aa profile/ Lathyrism patients/ Neurology/ Lathyrus sativus/ Amino acids/ Amino acids analysis/ Cerebrospinal fluid/ Excitatory amino acid/ Lathyrism/ Lathyrism cerebrospinal fluid/ Metabolism plant/ Motor neurons Neurolathyrism/ Neurons/ Prevalence/ reprint.

Khan, J. K.; Kuo, Y. H.; Haque, A., and Lambein, F. (1995). **Neurotransmitters in the cerebrospinal fluid and serum of neurolathyrism patients**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 111-117.
Source: reprintDE
Cerebrospinal fluid/ Cerebrospinal fluid amino acid analysis/ Human consumption L. sativus/ Neurolathyrism/ Neurologic Examination Neurology/ Neurotoxins/ Neurotoxins analysis/ Glutamates/ Glycine/ Lathyrus sativus/ reprint.

Khawaja, I.; Khawaja, H. I. T.; Ullah, I.; Raja, N. U., and Khushk, A. M. (1995). **Lathyrism in Pakistan: A preliminary survey**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 55-62.
Source: reprintDE
Pakistan/ Pakistan L. sativus/ Lathyrism epidemiology/ Lathyrism Pakistan/ Lathyrus sativus production/ ODAP/ Surveys/ Socioeconomics Lathyrus sativus/ reprint.

Kuo, Y. H.; Bau, H.-M.; Khan, J. K., and Lambein, F. (1995). **Detoxification of Lathyrus sativus meal by fermentation without loss of nutritive value**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 231-234.
Source: reprintDE

Fermentation/ Fermentation L. sativus/ Fermentation L. sativus detoxification/ Aspergillus oryzae/ Rhizopus oligosporus/ SDS PAGE/ Protein Protein electrophoresis/ ODAP/ ODAP analysis/ Nutrition/ Nutritive value/ Processing/ Processing L. sativus/ Processing methods L. sativus Tempeh/ Post harvest processing L. sativus/ Postharvest detoxification/ Detoxification/ Detoxification L. sativus/ Detoxification L. sativus fermentation/ Lathyrus sativus/ reprint.

Kuo, Y. H.; Khan, J. K., and Lambein, F. (1995). **Biosynthesis in vivo of the neurotoxin beta-ODAP in Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 15-20.
Source: reprintDE
Lathyrus sativus/ NPAA biosynthesis/ In vivo/ Biosynthesis/ ODAP biosynthesis/ Biochemistry L. sativus/ Biosynthesis ODAP/ ODAP Biochemistry/ reprint.

Kuo, Y. H.; Lambein, F.; Mellor, L. C.; Adlington, R. M., and Baldwin, J. E. (1995). **Biosynthesis of the neurotoxin beta-ODAP in callus tissue of Lathryus sativus: Incorporation of [N] - and [C] - precursors**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 21-24.
Source: reprintDE
Lathyrus sativus/ ODAP biosynthesis/ Biosynthesis ODAP/ Biochemistry/ reprint.

Lambein, F. (1995). **Collaborative projects on Lathyrus and human lathyrism coordinated by the University of Ghent, Belgium: Prospects for further research**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 261-267.
Source: reprintDE
BIA/ ODAP/ Lathyrus sativus low ODAP/ NATO/ EEC/ Isoxazolin-5-one/ Bangladesh/ Belgium/ ODAP/ Biosynthesis/ Biochemistry Lathyrus sativus/ reprint.

Mehra, R. B.; Raju, D. B., and Hima Bindu, K. (1995). **Breeding work on Lathyrus sativus L. at I.A.R.I., New Delhi**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 127-130.
Source: reprintDE
Genetic resources/ Genetics/ Genetics flower colour/ Polymorphism L. sativus/ Polymorphisms/ Flower colour polymorphism/ Flower colour ODAP/ ODAP L. sativus/ ODAP screening/ India/ Genetic resources L. sativus/ Lathyrus sativus/ reprint.

Mehta, S. L. (1995). **Strategies for toxin removal from Lathyrus sativus**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 275.
Source: reprintDE
Somaclones/ Somaclones L. sativus/ ODAP/ Lathyrus sativus low ODAP/ India/ Lathyrus sativus/ reprint.

Moges, G.; Johansson, G., and Solomon, T. (1995). **Determination of the neurotoxic amino acid ODAP using a redox enzyme, glutamate oxidase, in batch-wise or flow injection mode**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 73-79.
Source: reprintDE
ODAP analysis/ Analysis ODAP/ Glutamate oxidase/ Lathyrus sativus/ Biochemistry/ reprint.

Narayan, R. K. J.; Getachew, A., and Jadhav, A. (1995). **Genetic manipulation of the biosynthesis of beta-N-oxalyl-L-alpha, beta-diaminopropionic acid (beta-ODAP) in Lathyrus sativus: Problems and prospects**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 177-187.
Source: reprintDE
ODAP/ Molecular biology/ Genetics/ Lathyrus sativus/ ODAP biosynthesis/ Phenology/ Tissue culture/ Callus culture/ reprint.

Nunn, P. B.; Perera, K. P. W. C., and Bell, E. A. (1995). **Blood and urine analyses following the consumption of Lathyrus sativus seed by human volunteers**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 103-110.
Source: reprintDE
Human consumption L. sativus/ Human metabolism ODAP/ ODAP/ ODAP bioassay/ ODAP metabolism/ Volunteers/ Lathyrus sativus/ reprint.

Pandey, R. L. and Kashyap, O. P. (1995). **Studies on socio-economic strata and Lathryus consumption in Rural Madhya Pradesh**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 47-50.

Source: reprintDE
Madhya Pradesh/ India/ Rural/ Socioeconomics/ Socioeconomics L. sativus/ Socioeconomics lathyrism/ Nutrition/ Nutrition L. sativus Nutrition surveys/ Dhal/ Surveys/ Lathyrus sativus/ reprint.

Pooder, A. K. (1995). **Studies on the growth and physiology of Lathyrus nodule bacteria**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 277.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh L. sativus Rhizobium/ Lathyrus sativus/ Lathyrus sativus Rhizobium/ Rhizobium/ Rhizobium leguminosarum/ Rhizobium L. sativus/ reprint.

Rahman, M. K.; Sarker, M. A. H.; Uddin, M. A., and Naved, A. F. (1995). **Effect of Lathyrus sativus and vitamin C on the activities of aromatic L-amino acid decarboxylase and dipeptidyl aminopeptidase-IV in the central and peripheral tissues and serum of guinea pigs**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 243-247.
Source: reprintDE
Vitamin C/ Armoatic amino acid decarboxylase/ Amino acids metabolism/ Guinea Pigs/ Peripheral/ Peripheral nervous system/ Serum Dipeptidyl aminopeptidase/ Aminopeptidase/ Lathyrus sativus/ ODAP toxicity/ Toxicity L. sativus/ Toxicity ODAP/ Toxicity/ Vitamins/ reprint.

Rahman, M. M.; Quader, M.; Rahman, A.; Sarker, A.; Kumar, J.; Yusuf, H. K. M., and Malek, M. A. (1995). **Recent advances in breedin glow toxin khesari lines at BARI**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 153-160.
Source: reprintDE
BARI/ Bangladesh L. sativus/ Bangladesh L. sativus genetic resources/ Breeding/ Breeding L. sativus/ Breeding ODAP/ ODAP/ ODAP screening/ Genetic resources evaluation/ Lathyrus sativus low ODAP/ Toxin/ Genetic resources/ Lathyrus sativus/ reprint.

Roy, B. C.; Yusuf, H. K. M.; Khan, L. A.; Wouters, G.; Khan, J. K., and Lambein, F. (1995). **BIA toxicity in day-old chicks**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 280.
Source: reprintDE
BIA/ Beta (Isoxazolin 5 on 2 yl) L Alanine/ BIA toxicity/ Bioassay/ Bioassay chicks/ Poultry/ Poultry bioassay/ Lathyrus sativus/ reprint.

Sarwar, C. D. M.; Sarker, A.; Murshed, A. N. M. M., and Malek, M. A. (1995). **Variation in natural population of grass pea**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 161-164.
Source: reprintDE
Lathyrus sativus Bangladesh/ Lathyrus sativus genetic resources/ Lathyrus sativus genetic variation/ Bangladesh/ Bangladesh L. sativus Bangladesh L. sativus genetic resources/ Bangladesh ODAP/ ODAP/ Flower colour/ Genetic resources collecting/ Genetic resources/ Genetic resources L. sativus/ Genetic resources evaluation/ Lathyrus sativus/ reprint.

Shaikh, M. A. Q.; Majid, M. A., and Lahiri, B. P. (1995). **Mutant derivative low neurotoxin lines of grass pea (Lathyrus sativus)**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 165-166.
Source: reprintDE
Bangladesh/ Bangladesh L. sativus/ Bangladesh ODAP/ Mutagenesis/ Mutagenesis breeding L. sativus/ Mutants/ Lathyrus sativus/ reprint.

Swarup, I. and Lal, M. S. (1995). **Reaction of Lathyrus genotypes to powdery mildew (Erysiphe polygoni DC) under 'Upland conditions'**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 286.
Source: reprintDE
Powdery mildew/ Erysiphe polygoni/ Erysiphe/ India/ Phytopathology L. sativus/ Phytopathology/ Mycology/ Diseases plant/ Diseases L. sativus/ Lathyrus sativus/ reprint.

Tate, M. E.; Enneking, D.; Delaere, I.; Malaterre, C., and Glatz, P. C. (1995). **Towards the detoxification of Vicia sativa L.** In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 93-100.
Cultivars of Vicia sativa L. contain the favism toxin vicine, as well as gamma-glutamyl-beta cyanoalanine and in some cases the cyanogenic glycoside vicianine. Reports of the rising human consumption of Vicia sativa: cultivars with orange coloured cotyledons, such as the Vicia sativa cultivar Blanche Fleur, which mimics the colour and size of red lentils (Lens culinaris Medik) have stimulated the search for low toxin lines and detoxification procedures. Diffuse Reflectance Using Infrared Dispersion (DRUID) spectroscopy of the

absorbance of the nitrile group (-CN) near 2250 cm-1 provides a useful method for monitoring its presence in food or feed samples and also its loss during in situ acid catalysed hydrolysis of the seeds. It will also be important for screening germplasm.
Source: reprintDE
Vicia spp toxicity/ Postharvest detoxification/ Vicia sativa/ Poultry bioassay/ Layers/ Feed intake/ Egg production/ Poultry bioassay/ Lathyrus sativus/ Bioassay/ NPAA gamma glutamyl peptides/ Agriculture/ Genetic resources/ Beta cyanoalanine/ Beta Alanine analogs and derivatives Colour/ Cotyledons/ Cultivars/ Detoxification/ Dietary intake/ Dispersion/ Eggs/ Favism/ Feed/ Feed Vicia sativa/ Feed Lathyrus sativus/ Food Gamma glutamyl beta cyanoalanine/ Gamma glutamyl peptides/ Glycosides/ HCN/ Human consumption/ Hydrolysis/ Diet/ Dietary/ Intake Lathyrism Bioassay/ Lathyrus toxicity/ Layers/ Lens culinaris/ Humans/ Nitriles/ NPAA/ Peptides/ Postharvest/ Poultry/ Reports/ Screening Seed/ Toxicity L. sativus/ Toxicity/ Toxin/ Vicia spp/ Vicia/ Vicine/ reprint.

Tekle Haimanot, R.; Abegaz, B. M.; Wuhib, E.; Kassina, A.; Kidane, Y.; Kebede, N.; Alemu, T., and Spencer, P. S. (1995). **Nutritional and neuro-toxicological surveys of Lathryus sativus consumption in Northern Ethiopia**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 41-45.
Source: reprintDE
Socioeconomics/ Socioeconomics L. sativus/ Processing/ Processing methods L. sativus/ Production L. sativus/ Ethiopia/ Ethiopia L. sativus Ethiopia lathyrism/ Ethiopia Lathyrus food/ Ethiopia nutrition/ Ethiopia nutritional survey/ Lathyrus sativus/ reprint.

Willis, C. L.; Meldrum, B. S.; Nunn, P. B.; Anderton, B. H., and Leigh, P. N. (1995). **Neuronal damage, induced by beta-ODAP in rat hippocampus, can be prevented by the non-NMDA antagonist 2,3-dihydroxy-6-nitro-7-sulphamoyl-benzo(F)quinoxaline (NBQX)**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 285.
Results indicate that the acute in vivo hippocampal toxicity if beta-ODAP in the rat is mediated by AMPA receptors, rather than by KA or NMDA receptors. Neurones in the rat hippocampus did not die immediatley on exposure to beta-ODAP, but via a process involving sustained AMPA receptor activation. It is proposed that excitotoxic processes acting via AMPA receptors may play a role in the loss of upper motor neurones that occurs in neurolathyrism.
Source: reprintDE
ODAP/ ODAP toxicity mechanism/ NMDA/ NMDA receptors/ AMPA receptors/ KA receptors/ Neurology/ Neurons/ Neurotoxicity/ Rats Rodents/ Neurolathyrism/ NBQX/ Lathyrus sativus/ reprint.

Wouters, G.; Lambein, F.; Haque, A.; Hussain, M., and Yusuf, H. K. M. (1995). **Progress and prospects in the Bangladesh/Belgium Inter-University project**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 255-260.
Source: reprintDE
Lathyrus sativus/ Bangladesh/ Belgium/ HTLV-1/ Osteolathyrism/ Epidemiology lathyrism/ Lathyrism epidemiology/ Demography Socioeconomics/ ODAP analysis/ Poultry bioassay/ Zinc/ Environmental effects/ Trace elements/ reprint.

Yadav, C. R. and Neupane, R. K. (1995). **Genetic evaluation and breeding program of grass pea in Nepal**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 274.
Source: reprintDE
Lathyrus sativus/ Lathyrus sativus breeding/ Nepal/ Nepal L. sativus/ reprint.

Yu, Jing-Zhong (1995). **Cultivation of grass pea and selection of lower toxin varieties and species of Lathyrus in China**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 145-151. (author affiliation: The Soil and Fertilizer Institute, Academy of Agricultural Sciences Yangling, Shaanxi 712100, P.R. of China).
Our results show that the grass pea (Lathyrus sativus L.) is tolerant to drought and barren land, and that it is resistant to pea weevil.About 20,000 ha of grass pea were grown in North Shaanxi in recent years, with a stable yield 20% higher than pea (Pisum sativum L.). Human lathyrism was a serious problem in the Chinese province of Gansu in the seventies.The same varieties grown in different localities produced seeds with the same content of ODAP. From 50 varieties of L. sativus (with 0.03 to 0.87% ODAP) we selected six varieties with toxin content of 10.2%, giving virtually no visible symptoms in young chicks. One species of Lathyrus was found to be free of ODAP. Different varieties of grass pea or different species of Lathyrus have different compositions of esterase isozymes. This variability may be useful as a method to identify grass pea varieties, to select the parents for cross-breeding as a strategy for developing lower toxin varieties of Lathyrus sativus.
Source: reprintDE
Lathyrus sativus/ Lathyrus cicera/ Lathyrus latifolius/ Lathyrus odoratus/ Lathyrus sativus China/ Lathyrus sativus low ODAP/ Lathyrus sativus ODAP/ Lathyrus sativus ODAP screening/ Lathyrus sylvestris/ China/ China Shaanxi/ China Gansu/ Shaanxi/ Gansu/ China L. sativus

China L. sativus chemical analysis/ China L. tingitanus/ Toxin/ Varieties/ Varieties L. sativus/ Lathyrus sativus varieties/ Yield/ Yield L. sativus Yield L. cicera/ reprint.

Yusuf, H. K. M.; Haque, K.; Uddin, A.; Roy, B. C., and Lambein, F. (1995). **Homoarginine antagonises the toxicity of Lathyrus toxin in 1-day-old chicks.** Bangladesh Journal of Physiology and Pharmacology **10** (2):74-75 (author affiliation: Biochemistry (Human Nutrition Lab.) University of Dhaka, Dhaka 1000, Bangladesh; and Laboratory of Physiological Chemistry, University of Ghent, B-9000 Ghent, Belgium) Meeting abstract.
Source: Lambein_95_5; reprintDE
Lathyrus sativus toxicity/ Lathyrism/ Chick bioassay-ODAP antagonism/ Antagonism ODAP-homoarginine/ ODAP-homoarginine antagonism ODAP toxicity/ Biochemistry/ Lathyrus sativus/ Bioassay/ Bioassay L. sativus/ Lathyrus sativus bioassay/ Antagonism amino acids Bangladesh/ Chemistry/ Chickens/ Belgium/ Homoarginine/ Lathyrism Bangladesh/ Lathyrism Bioassay/ Lathyrism Biochemistry/ Lathyrism nutrition/ Lathyrism ODAP toxicity/ Lathyrus toxicity/ Humans/ Nutrition/ ODAP/ Physiology not plant/ Phytochemistry/ Poultry/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity L. sativus poultry/ Toxicity/ Toxin/ reprint.

Yusuf, H. K. M.; Roy, B. C.; Khan, L. A; Al-Monsoor, M. M.; Sarker, S.; Mohiduzzaman, M., and Quazi, S. (1995). **Studies on a toxin-free Lathyrus protein concentrate**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, pp. 225-230.
Source: reprintDE
Post harvest processing L. sativus/ Protein isolates/ Protein L. sativus/ Protein quality L. sativus/ Protein quality/ Digestibility/ Amino acid composition/ Nutritive value/ Lathyrus sativus/ Bangladesh/ Toxin/ reprint.

Yusuf, H. K. M.; Roy, B. C.; Sarkar, S.; Wouters, G., and Lambein, F. (1995). **ODAP toxicity in chicks: zinc appears to have a protective role**. In : Yusuf, H. K. M. and Lambein, F. (Eds). **Lathyrus sativus and Human Lathyrism: Progress and Prospects**, Dhaka: University of Dhaka, p. 279.
Source: reprintDE
ODAP/ ODAP toxicity ions/ ODAP Zinc/ Zinc/ Zinc lathyrism/ Poultry/ Chick bioassay/ Chickens/ Bangladesh/ Bangladesh lathyrism Bangladesh nutrition/ Lathyrus sativus/ reprint.

Haque, A.; Hossain, M.; Wouters, G., and Lambein, F. (1996). **Epidemiological study of lathyrism in Northwestern districts of Bangladesh.** Neuroepidemiology **15** (2):83-91 (author affiliation: Lambein F State Univ Ghent Physiol Chem Lab Kl Ledeganckstr 35 B-9000 Ghent BelgiumState Univ Ghent Physiol Chem Lab B-9000 Ghent BelgiumInst Postgrad Med & Res Dept Neurol Dhaka Bangladesh)
Two northwestern districts of Bangladesh with a population of 629,752 were surveyed from June 1991 to March 1993 to detect and follow up lathyrism patients. Out of 2,567 neurological patients, 882 were diagnosed as having lathyrism, giving a prevalence rate of 14.0/10,000. This prevalence was higher among young males: only 12.9% of the patients were female, and only 19.3% of the patients were over 30 years of age at onset of the disease. The average family size was 4.6 members. In the surveyed area, 730 families were evaluated: 622 families had only 1 affected member, and 108 families had 2-8 affected members. Most of the patients were working, while only 4% were not. The majority of the patients had a very low intake of animal protein. A few cases of human T-lymphotropic virus infection and osteolathyrism were found during this study. [References: 28].
Source: reprintDE
Animal Protein Intake/ Bangladesh lathyrism/ Lathyrism Epidemiology/ Human nutrition animal protein/ HTLV/ Osteolathyrism Bangladesh Osteolathyrism human/ Virology/ Osteolathyrism/ Age/ Bangladesh/ Epidemiology lathyrism/ Female/ Belgium/ Infection/ Intake/ Lathyrism Lathyrism animals/ Lathyrism Bangladesh/ Lathyrism nutrition/ Lathyrism viral infection/ Males/ Humans/ Nutrition animal/ Nutrition Population/ Prevalence/ Protein/ Reprint.

Ikonomidou, C.; Qin, Y. Q.; Labruyere, J., and Olney, J. W. (1996). **Motor neuron degeneration induced by excitotoxin agonists has features in common with those seen in the sod-1 transgenic mouse model of amyotrophic lateral sclerosis.** Journal of Neuropathology and Experimental Neurology **55** (2):211-224 (author affiliation: Olney Jw Washington Univ Sch Med Dept Psychiat 4940 Childrens Pl St Louis, Mo 63110 Usa)
A superoxide dismutase 1 (SOD-I) genetic defect has been identified in familial amyotrophic lateral sclerosis (ALS) and motor neuron degeneration has been described in SOD-1 transgenic mice. Because an excitotoxic mechanism has been implicated in ALS, we undertook studies to provide a description of excitotoxic degeneration of spinal motor neurons for comparison with the degenerative process observed in SOD-I transgenic mice. Excitotoxin agonists selective for each of the three major types of ionotropic glutamate receptors were applied directly onto the lumbar spinal cord of 21-day-old rats following posterior laminectomy. N-methyl-D-aspartate (NMDA) preferentially affected dorsal horn neurons, whereas the non-NMDA agonist, kainic acid, preferentially affected motor neurons. Cytopathological changes in motor neurons closely resembled those described in SOD-1 mice. These changes consist of massively swollen

dendritic processes in the presence of well-preserved presynaptic axon terminals; cell bodies of motor neurons tilled with vacuoles that originate both from endoplasmic reticulum and mitochondria; pleomorphic changes in mitochondria; axons of motor neurons becoming swollen proximally with accumulation of vacuoles, organelles, filaments, and degeneration products in the swollen segment. The observed changes in motor axons resemble changes described in the spinal cord of ALS patients. These findings are consistent with the proposal that motor neuron degeneration in ALS may be mediated by an excitotoxic process involving hyperactivation of non-NMDA glutamate receptors. [References: 55].
Source: Copyright Current Contents
AMPA/ Amyotrophic lateral sclerosis/ Dl-homocysteic acid/ Excitotoxicity/ Kainic acid/ Nmda/ Sod-1/ Rat spinal-cord/ Abnormal glutamate metabolism/ Amino-acids Parkinsonism-dementia/ Axonal swellings/ Cell-culture/ Kainic acid Brain/ Neurotoxicity/ Lathyrism.

Kusamaeguchi, K.; Ikegami, F.; Kusama, T.; Lambein, F., and Watanabe, K. (1996). **Effects of beta-ODAP and its biosynthetic precursor on the electrophysiological activity of cloned glutamate receptors.** Environmental Toxicology and Pharmacology **2** (4):339-342
3-N-Oxalyl-L-2,3-diaminopropanoic acid (beta-ODAP) induces neurolathyrism, a motor neuron disease. To elucidate the pathogenic mechanism of this process, the action of beta-ODAP on the excitatory amino acid (EAA) receptor-mediated currents was examined using cloned EAA receptors expressed in Xenopus oocytes. On the voltage-clamp recordings of an AMPA receptor(alpha(1)/alpha(2) heterooligomer), beta-ODAP was a strong agonist on this receptor, the potency being almost the same as L-glutamate. On the other hand, beta-ODAP had little effect on the glutamate-evoked currents through the expressed NMDA receptor (NR1(A) NR2A), but showed a weak inhibitory effect on the glycine-modulatory site. beta-ODAP may cause the neurodegenerative disease, neurolathyrism, mainly through the excitotoxic interaction with AMPA receptors. [References: 16].
Source: Reprinted with permission of the authors
AMPA receptor/ NMDA receptors/ Neurology/ ODAP/ Xenopus oocyte/ Neurolathyrism/ Lathyrus sativus toxicity/ Lathyrus sativus/ Toxicity Lathyrism.

Ludolph, A. C. and Spencer, P. S. (1996). **Toxic models of upper motor neuron disease.** Journal of the Neurological Sciences **139** (Suppl S):53-59 (author affiliation: Ludolph Ac Humboldt Univ Berlin Dept Neurol Schumannstr 20-21 D-10098 Berlin GermanyOregon Hlth Sci Univ Dept Neurol Portland, Or 97201 UsaOregon Hlth Sci Univ Ctr Res Occupat & Environm Toxicol Portland, Or 97201 Usa)
Although neurotoxic models for progressive degeneration of both the anterior horn cell and the Betz cell do not exist, (neuro)lathyrism and neurocassavism (konzo) are examples of self-limiting neurotoxic disorders that predominantly target the Betz cell. Both disorders are caused by the continuous intake of neurotoxic plant products (Lathyrus sativus and Manihot esculenta, respectively) which result in a virtually identical clinical picture of spastic paraparesis. A neurotoxic excitatory amino acid and AMPA agonist (beta-N-oxalylamino-L-alanine, BOAA) is held largely responsible for lathyrism. Epidemics of konzo are strongly associated with increased intake of the cyanide-liberating glycoside linamarin by protein-poor subjects. Whereas an animal model for neurocassavism does not exist, macaques fed Lathyrus sativus or BOAA develop central motor deficits with corticospinal tract involvement. Estimated dosages of Lathyrus sativus used to induce beginning lathyrism in well-nourished primates are 10-20 fold greater than those associated with irreversible human neurolathyrism. Major unexplained aspects of both diseases are the factors which allow the suspected toxins to target Betsz cells (blood-brain barrier, receptor distribution, cellular energy metabolism), the latency to onset in both diseases, and how two separate etiologic factors trigger clinically similar disorders. [References: 58].
Source: Copyright Current Contents
Motor neuron disease/ Neurolathyrism/ Neurocassavaism/ Konzo/ Free Radical/ ODAP/ Neurology/ Antinutritional factors/ Lathyrus sativus Beta Alanine analogs and derivatives/ Amino acids/ AMPA receptors/ Anterior horn/ Blood brain barrier/ Blood/ Brain/ Cyanides/ Energy Energy metabolism/ Excitatory amino acid/ Glycosides/ HCN/ Intake/ Lathyrism/ Lathyrism animal models/ Lathyrism animals/ Lathyrism chronic Cassava toxicity/ Lathyrism motor neurons/ Lathyrus toxicity/ Primates/ Humans/ Manihot esculenta/ Cassava/ Metabolism/ Models Motor neurons/ Neurons/ Neurotoxins/ Protein/ Receptors/ Spasticity/ Spastic paraparesis/ Toxicity ODAP/ Toxicity L. sativus/ Toxicity/ Toxin USA.

Reed, P. J.; Dickens, J. S. W., and Oneill, T. M. (1996). **Occurrence of anthracnose (Colletotrichum acutatum) on ornamental lupin in the united kingdom.** Plant Pathology **45** (2):245-248 (author affiliation: Reed Pj Maff Cent Sci Lab Hatching Green Harpenden Al5 2bd Herts EnglandAdas Hort Cambridge Cb2 2bl England)
The first recorded outbreak of anthracnose (Colletotrichum acutatum) on ornamental lupin in the United Kingdom occurred in 1989. Seedborne infection by Colletotrichum acutatum was investigated after seed was implicated in the origin of the outbreaks and infection was found on seed of three of 14 cultivars tested. In pathogenicity tests, typical anthracnose symptoms developed only on plants of Lupinus spp; there were slight

symptoms on Pisum sativum, Vicia sativa and Lathyrus odoratus, but none on Vicia faba, Phaseolus coccineus, P. vulgaris and Onobrychis viciaefolia. [References: 9].
Source: Copyright Current Contents
Lathyrus odoratus/ Anthracnose L. odoratus/ Colletotrichum acutatum host range/ Lathyrus odoratus/ Lathyrism symptoms/ Anthracnose/ Colletotrichum/ Cultivars/ England/ Fungi/ Mycology/ Hatching/ Horticulture/ Horticulture L. odoratus/ Hosts/ Host range/ Infection/ Lathyrism/ Lupinus/ Microbiology/ Onobrychis viciaefolia/ Ornamentals/ Ornamentals L. odoratus/ Pathogenicity/ Phaseolus/ Pisum sativum/ Seed/ Seed borne/ Symptoms lathyrism/ UK/ Vicia/ Vicia faba/ Vicia sativa.

Robertson, L. D.; Singh, K. B.; Erskine, W., and Abd El Moneim, A. M. (1996). **Useful genetic diversity in germplasm collections of food and forage legumes from West Asia and North Africa.** Genetic Resources and Crop Evolution **43** (5):447-460
The germplasm collections at ICARDA of faba bean, chickpea, lentil and forage legumes have been exploited by breeding programmes in the West Asia and North Africa region for production of improved cultivars. The first lines distributed were taken directly from the germplasm collections after initial evaluation. This formed the first flush of releases by national programmes, with 56 of 105 cultivars emanating from germplasm. A systematic evaluation of the food legumes for a wide range of morpho-agronomic characters based on the IBPGR/ICARDA descriptors has led to publication and widespread distribution of catalogues which, in turn, have led to an extensive use of the germplasm by national breeding programmes. In the period of 1990-1994, more than 5000 accessions of food legumes and more than 1900 accessions of forage legumes have been distributed per year. The most important use made of the germplasm collections has been their exploitation as a source for resistances and tolerances to biotic and abiotic stresses. These legumes often suffer severe yield loss due to disease and environmental stress; consequently, screening procedures were developed for the major biotic and abiotic stresses and were successfully applied in selecting sources of resistances and tolerances. The germplasm collections have also been used to improve the nutritional quality of these crops, both for human and animal consumption. Most of the food legume collections have been screened for protein content. The Lathyrus spp. collections have yielded lines with low levels of the neurotoxin ODAP (beta-N-Oxalyl-L-alpha,beta-Diaminopropionic Acid), which causes Lathyrism in humans and animals. These lines are being used extensively in the breeding programme. In addition to maintaining collections of the cultigens, ICARDA has also assembled large collections of wild relatives and progenitors of lentil and chickpea; and wild and weedy forms of the forage legume species. In the past five years the wild Lens and Cicer collections have been evaluated for resistances to biotic and abiotic stresses. These have been useful in providing sources of new, improved or multiple-stress resistance. They have also been useful in increasing yield potential and adaptation of the cultigens. [References: 71].
Source: reprintDE
Cicer arietinum/ Genetic resources collection/ Lathyrus spp Genetic resources/ Lens culinaris/ Vicia faba/ Vicia spp Genetic resources/ Genetic resources Lathyrus spp/ ODAP/ Forage/ Adaptation/ ICARDA/ Agriculture/ Genetic resources/ Africa/ Asia/ Cultivars/ Descriptors Distribution plants/ Environment/ Evaluation genetic resources/ Evolution/ Food/ Forage Syria/ Genetic diversity/ Genetic resources collecting Grain legumes/ Pulses/ Grain legumes evolution/ Grain legumes genetic resources/ Lathyrism animals/ Lathyrus spp/ Humans/ Neurotoxins North Africa/ Africa North/ Protein/ Protein content/ Quality/ Resistance/ Screening/ Stress/ Syria/ Syria genetic resources/ Vicia spp/ Vicia Weed/ Wild relatives/ Wild/ Yield/ Yield fodder/ Genetic resources evaluation/ Reprint.

Tiwari, K. R. and Campbell, C. G. (1996). **Inheritance of neurotoxin (ODAP) content, flower and seed coat colour in grass pea (Lathyrus sativus L).** Euphytica **91** (2):195-203 (author affiliation: Tiwari Kr Natl Grain Legume Res Program Rampur Chitawan NepalAgrifood Diversificat Res Ctr Morden Mb R6m 1y5 Canada)
A strong epidemiological association is known to exist between the consumption of grass pea and lathyrism. A neurotoxin, beta-N-Oxalyl-L-alpha, beta-diaminopropanoic acid (ODAP) has been identified as the causative principle. This study was undertaken to investigate the mode of inheritance of the neurotoxin ODAP, flower and seed coat colour in grass pea. Five grass pea lines with low to high ODAP concentration were inter-crossed in all possible combinations to study the inheritance of the neurotoxin. Parents, F-1 and F-2 progenies were evaluated under field condition and ODAP analyzed by an o-phthalaldehyde spectrophotometric method. Many of the progenies of low x low ODAP crosses were found to be low in ODAP concentration indicating the low ODAP lines shared some genes in common for seed ODAP content. The F-1 progenies of the low ODAP x high ODAP crosses were intermediate in ODAP concentration and the F-2 progenies segregated covering the entire parental range. This continuous variation, together with very close to normal distribution of the F-2 population both of low x low and low x high ODAP crosses indicated that ODAP content was quantitatively inherited. Reciprocal crosses, in some cases, produced different results indicating a maternal effect on ODAP concentration. Blue and white flower coloured lines of grass pea were inter-crossed to study the inheritance of flower colour. Blue flower colour was dominant over the white. The F-2 progenies segregated in a 13:3 ratio indicating involvement of two genes with inhibiting gene

interactions. The gene symbol LB for blue flower colour and LW for white flower colour is proposed. [References: 33].
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Flower Colour/ ODAP inheritance/ Lathyrus sativus genetics/ Genetics L. sativus/ Breeding/ ODAP genetics/ Breeding ODAP/ ODAP inheritance/ Genetics ODAP/ Genetics L. sativus/ Lathyrus sativus genetics/ Genetics cytoplasmic factors/ ODAP biosynthesis cytoplasm Lathyrus sativus/ Biosynthesis/ Colour/ Flower colour genetics/ Flowers/ Genes/ Genetics/ Genetics flower colour/ Grain legumes/ Pulses Maternal/ Neurotoxins/ O phthalaldehyde/ ODAP/ ODAP biosynthesis/ Population/ Seed/ Seed coats.

Haque, A.; Hossain, M.; Lambein, F., and Bell, E. A. (1997). **Evidence of osteolathyrism among patients suffering from neurolathyrism in Bangladesh**. Natural Toxins **5** (1):43-46.
In a study of 500 patients suffering from neurolathyrism in Bangladesh it was found that 60 (all male) complained of bone pain and showed skeletal deformities suggestive of osteolathyrism. On X-ray examination a failure of fusion in both vertebral and iliac epiphyses was found in two patients. At the age of these patients (30 and 37 years) such failure was considered a clear evidence of osteolathyrism. All 60 patients were accustomed to eating the green parts of Lathyrus sativus, which contain 2-cyanoethyl-isoxazolin-5-one, a compound that chemically and metabolically can produce the osteolathyrogen beta-aminopropionitrile (BAPN), as well as foods made from the seeds of the same plant which contain the neurotoxin 3-N-oxalyl-2,3-diaminopropanoic acid (beta-ODAP).
Source: reprintDE
Lathyrus sativus/ Osteolathyrism/ Lathyrism/ Neurolathyrism/ Isoxazolin-5-one/ BAPN/ ODAP/ 2 Cyanoethylisoxazolin 5 one/ Isoxazolin-5-one toxicity/ NPAA 2-(2-cyanoethyl)-3-isoxazolin-5-one/ Bangladesh/ reprint.

Kusamaeguchi, K.; Kusama, T.; Ikegami, F.; Lambein, F., and Watanabe, K. (1997). **Inhibitory activity of a naturally occurring heterocyclic beta-substituted alanine, beta-(isoxazolin-5-on-4-yl)-l-alanine, on the l-glutamate/l-aspartate transporter (glast) expressed in xenopus oocytes.** Molecular Brain Research **52** (1):166-169 (author affiliation: Nihon Univ Coll Pharm Biol Lab Funabashi Chiba 274 Japan)
Excitatory amino acid (EAA) transporters are of physiological importance in the regulation of the extracellular concentration of excitatory amino acids and the neuroexcitation in CNS. Among four identified transporters, the Na+-dependent high-affinity L-glutamate/L-aspartate transporter (GLAST) is highly expressed in glial cells. Here, we report a naturally occurring inhibitor of GLAST, derived from bovine retina, using the Xenopus oocyte expression system. beta-(Isoxazolin-5-on-4-yl)-L-alanine (TAN), an antifungal antibiotic, inhibited [C-14]L-glutamate (L-Glu) transport into GLAST-expressing oocytes. TAN also served as a substrate for this transporter in voltage-clamp experiments measuring the current coupled to the EAA transport. The maximum current of TAN itself was approximate to 1/3 of that of L-glutamate, and its apparent affinity was almost the same as L-Glu. In combination with L-Glu, TAN antagonized L-glutamate transport. In radioisotope experiments, the inhibitory potency of this compound against [C-14]L-Glu uptake into oocytes was approximate to 1/6 of that of L-(-)-threo-3-hydroxyaspartate (THA). The glucoside of TAN (TANG), occurring in seedlings of the garden pea, the lentil and some Lathyrus species, did not show any electrophysiological activity nor was it transported into oocytes. It is proposed that TAN is a novel type antagonist of natural origin on GLAST. By affecting such transport system, naturally occurring compounds may affect the regulation of the extracellular level of endogenous EAA. (C) 1997 Elsevier Science B.V. [References: 18].
Glast/ Sodium-dependent transporter/ Oocyte/ Xenopus/ Neurolathyrism/ Lathyrus toxin/ Beta-(isoxazolin-5-on-4-yl)-l-alanine/ Beta-odap Rat-brain/ Functional-analysis/ Lathyrism/ Receptors Acid.

Melka, A.; Tekle Haimanot, R., and Lambein, F. (1997). **Symptomatic treatment of neurolathyrism with tolperizone HCl (mydocalm) - a randomized double blind and placebo controlled drug trial.** Ethiopian Medical Journal **35** (2):77-91
The efficacy and safety of oral Tolperisone HCL was evaluated in double blind, placebo-controlled, randomized trial in 72 patients with neurolathyrism in stages I, II, and III of the disease at Kolla Duba Health Centre of Dembia District of North Gondar between January and April 1995. Taken orally daily for 12 weeks, tolperisone: HCL (Mydocalm) in a dose of 150 milligrams (mgs) twice daily significantly improved subjective complaints such as muscle cramps,: heaviness of the legs, startle attacks, flexor spasms and repeated falls;, An overall subjective improvement was observed in 75% of the patients on tolperisone HCL and 39% of the placebo group (P=0.002). When-objectively assessed spastic muscle tone in the abductors, stiffness of Achilles and spontaneous ankle clonus were significantly reduced in tolperisone HCL group (P values = 0.001 0.04, and 0.0001, respectively). Walking ability and speed of walking was also significantly improved. The drug is most effective in relieving symptoms of stage I and stage II disease. Some adverse effects like muscle pain, generalized body-weakness and, dizziness were recorded in patients taking the drug but all were minor and self limited, none requiring discontinuation of treatment. It is concluded that tolperisone is a well tolerated and efficacious drug for symptomatic treatment of neurolathyrism. [References: 17].

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Lathyrism/ Tolperisone/ Ethiopia/ Symptomatic treatment.

Padmajaprasad, V.; Kaladhar, M., and Bhat, R. V. (1997). **Thermal isomerisation of beta-n-oxalyl-l-alpha, beta-diaminopropionic acid, the neurotoxin in Lathyrus sativus, during cooking.** Food Chemistry **59** (1):77-80 (author affiliation: Indian Council Med Res Natl Inst Nutr Po Jamai Osmania Hyderabad 500007 Andhra Pradesh India Indian Council Med Res Natl Inst Nutr Hyderabad 500007 Andhra Pradesh India)
The naturally occurring beta-form of N-oxalyldiaminopropionic acid (beta-ODAP) present in Lathyrus sativus is the main neurotoxic principle implicated in neuro-lathyrism. The alpha-form of ODAP has been shown to be less toxic to experimental animals. Therefore, the extent of isomerisation of the toxin from the beta-form to the alpha-form during cooking might determine the toxicity of L. sativus seed. The results of the present study reveal that there is a temperature- and time-dependent isomerisation of the beta-form to the alpha-form. The extent of conversion of beta-ODAP to its alpha-form was determined in some common Indian cooking preparations and was found not to exceed 40%. It seems likely that the toxicity of L. sativus seed due to beta-ODAP is only partially removed during cooking and that a significant proportion of the toxin (about 60%) remains as the toxic beta-form. (C) 1997 Elsevier Science Ltd. All rights reserved. [References: 21].
ODAP isomerism/ Isomerism ODAP/ Lathyrus sativus processing/ Processing L. sativus.

Tekle Haimanot, R. and Lambein, F. (Eds) (1997). Lathyrus and Lathyrism. A decade of progress, in Addis Ababa, Ethiopia. Published in Ghent, Belgium: University of Ghent139 pp. ISBN: 90-803685-1-2.
Lathyrus sativus/ Lathyrus sativus review/ Review L. sativus/ Lathyrism/ Lathyrism review/ Review lathyrism.

Awasthi, S. and Boor, P. J. (1998). **Allylamine and beta-aminopropionitrile-induced vascular injury - enhanced expression of high-molecular-weight proteins.** Journal of Toxicology and Environmental Health **53** (1):61-76 (author affiliation: Boor Pj Univ Texas Med Branch Dept Pathol Chem Pathol Div Galveston, Tx 77555 Usa)
In the present study we describe changes in aorta at the protein level associated with allylamine (AA) and beta-aminopropionitrile (beta APN) induced vascular toxicity in a rat model. This model represents a remarkable synergistic, necrotizing toxic effect of these combined toxins, and our rationale was to examine protein expression in order to shed light on the mechanisms underlying this synergism. Rats were given AA (100 mg/kg body weight/day) and beta APN (1 g/kg body weight/day) by gavage for 10 d; this protocol has been shown to result in smooth-muscle necrosis, but no visible connective tissue changes. Soluble and insoluble fractions from AA + beta APN-or from beta APN-treated aorta showed enhanced expression of three high-molecular-weight protein bands (ranges between approximately 120 and 95 kD). The time course of induction of proteins showed the appearance of AA + beta APN-induced specific proteins at d 3 of AA + beta APN treatment. Partial purification and characterization suggested that AA + beta APN specific proteins are likely to be collagen proteins (type I). Thus, the data presented in this article help in understanding the vascular toxicity induced by AA + beta APN or by beta APN, in that we have described an altered phenotypic expression of collagenous proteins indicative of selective medial vascular toxicity. [References: 28].
Source: Copyright Current Contents
Smooth-muscle cells/ Sensitive amine oxidase/ Gel-electrophoresis Toxicity/ Collagen/ Rat/ Lathyrism/ Coronary/ Disease Invitro.

Bruel, A.; Ortoft, G., and Oxlund, H. (1998). **Inhibition of cross-links in collagen is associated with reduced stiffness of the aorta in young rats.** Atherosclerosis **140** (1):135-145 (author affiliation: Aarhus Univ Inst Anat Dept Connect Tissue Biol Dk-8000 Aarhus C Denmark)
Collagen and elastin fibres are of major importance in providing the aorta with tensile strength and elasticity. The presence of cross-links in collagen and elastin is essential for the mechanical stability of collagen and elastin fibres. beta-aminopropionitrile (BAPN) reduces the formation of cross-links by inhibiting the enzyme lysyloxidase. Young rats were injected with BAPN to inhibit the formation of cross-links, and the changes in the biomechanical and biochemical properties of the thoracic aorta were studied. The biomechanical analyses of aortic samples from BAPN-treated rats showed a significantly increased diameter (1.64 +/- 0.02 mm), a significantly reduced maximum load (1.08 +/- 0.08: N), and a significantly reduced maximum stiffness (3.34 +/- 0.10 N) compared with controls (1.57 +/- 0.02 mm, 1.55 +/- 0.04 N and 4.49 +/- 0.14 N, respectively). No changes in the concentrations of collagen and elastin were found. The content of pyridinoline? a mature collagen cross-link, was significantly decreased by 49% in the BAPN-treated group compared with controls. No changes in the concentration of desmosine+ isodesmosine, the major cross-links of elastin, were found. The present study shows that cross-links are essential in providing mechanical stability of the aorta. Even a partial inhibition of the cross-linking processes results in a destabilisation of the aortic wall with increased diameter and reduced strength and stiffness. (C) 1998 Elsevier Science Ireland Ltd. kll rights reserved. [References: 60].

Rat/ Lathyrism/ Aorta/ Biomechanics/ Collagen/ Elastin/ Pyridinoline/ Desmosines/ Performance liquid-chromatography Beta-aminopropionitrile/ Biomechanical properties/ Hydroxypyridinium crosslinks/ Mechanical-properties/ Coronary angioplasty/ Balloon angioplasty/ Hypertensive rats/ Marfan-syndrome Blood-pressure.

Getahun, H. and Tekle Haimanot, R. (1998). **Psychosocial assessment of lathyrism patients in rural Estie district of South Gondar, northern Ethiopia.** Ethiopian Medical Journal **36** (1):9-18 (author affiliation: Getahun H S Gondar Hlth Dept Pob 67 Debre Tabor Ethiopia)

Three hundred and thirty three patients in the lathyrism endemic rural Estie district of Northern Ethiopia were interviewed and examined to assess the psychosocial impacts of neurolathyrism. The majority of the affected were in the age group of 11-20 years (43%) followed by 21-30 years (29%). Males were more affected than females (4.8:1). Peak 1 occurrences of neurolathyrism was observed at time of mobilization of the population in villagization and land diversification schemes. Females were affected to lesser extent and at an earlier age than males. Neurolathyrism affected matrimony among the rural farming population where marriage is considered as the most significant social achievement of any young member of the society. Divorce rate due to paralysis was 28%. It also influenced the choice of occupation among the afflicted rural people. Many males went into ecclesiastical professions. A significant number of males also took up occupations which traditionally were considered to be exclusively for women like basketry and embroidery. More females, not withstanding their age, were engaged in cattle-keeping. During the study, the rural communities were made aware of the association of neurolathyrism and consumptions of grass pea seed. It is believed that this step will enable communities to use home-based detoxifying methods and resort to alternate crops during times of food shortage. [References: 11].

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Lathyrism/ Ethiopia/ Epidemiology.